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BRIEFLY TOLD.

THE NERNST LIGHT.—In these days of capital making one must wonder, having had time to ponder, how strong is the faith of the capitalist who, with supreme indifference to the ordinary laws which govern natural development and commercial trading, puts his money, and much of it, in schemes that, on their face, propose to overturn nature and to give a new direction to commerce. A brilliant example of this sort of revolution is afforded by the efforts of those who are exploiting the "Nernst light," and this reference thereto is prompted by a recent letter from a correspondent, whose reputation as a gas engineer is international, but who prefers to cover his light rather than that it should shine through the printing of his name. Our correspondent writes:

"In the New York *Herald* for the 30th ult. I read a statement respecting the Nernst light, the lines of which would indicate that 'capital' will be made from it, possibly to the disadvantage of the gas industry, and for that reason I trouble you with this letter. The invention of Professor Nernst has been mentioned here and there, sporadically, as it were, for 18 months or more, and I think I have written you concerning the same, at about the time of the announcement of the discovery that non-conductors of electricity, under ordinary conditions, become excellent conductors when heated, which discovery may be fairly laid to the researches of Prof. Nernst. He uses thin rods, composed of a mixture of magnesia and porcelain, as the light-giving medium; but as these materials, when cold, will not conduct electricity, a preheating becomes absolutely necessary. Herr Bussman, Chief Engineer of the General Electric Company, Berlin, Germany, notes in this connection that, before the material of which the lamp is made can be caused to act as a competent or sufficient conductor of electricity to serve usefully as a light, it must be heated to 700° C. (1,292° F.), 'which,' continues the same authority, 'can be best accomplished by holding a lighted match under the lamp for from 9 to 10 seconds.' This would seem to be rather an impracticable method of starting or causing an electrical light to glow. Other methods, however, have been proposed and used; such, for instance, as the heating of a fine platinum wire, intended in turn to heat a thin rod of porcelain, which last would heat the lamp. This sounds more complicated than it really is in practice; but in any event the thing is sufficiently complicated. The advantage of the Nernst incandescent lamp over the ordinary glow lamp is that it does not require a vacuum for its existence, thus doing away with the glass bulb. Again, it can be brought to a very much higher heat, thus affording a much brighter light from a given expenditure of electrical energy. Professor Nernst is what may be a termed a pure scientist, and is undoubtedly in his real domain a man who is an honor by himself and to his fellows, but when he speaks as an inventor, he seems to be subject to the usual failings of those in the latter class, who undeniably are inclined to over estimate the values of the products of their genius. For instance, Prof. Nernst, when delivering a lecture some time ago in the Hall of the Berlin General Electric Company, ventured to assert his belief that his lamp would speedily reconquer for electricity the ground and position lost to the latter by reason of the success of the incandescent gas light. Such belief and averment seem, however, not to be shared without reserve by the Company that has un-

dertaken its manufacture, for Herr Bussman (whom I have mentioned above), in describing the manufacture of the new lamp, emphatically stated he wished it distinctly understood that his Company would continue to make the ordinary glow lamps, and that it had no thought that the Nernst lamp was likely to displace the older incandescent lamp in the appreciable future."

NOTES.—It is reported that Messrs. A. R. Kuser and William Perrine, of Trenton, N. J., and John C. Moore, of Philadelphia, have purchased the plant and properties of the Mt. Holly (N. J.) Gas Company. If they in time do as well for themselves out of it as did the old farmer (C. Foster Cox) who owned and operated it for the past five years or so, they will have done well.——The New York newspapers of last Wednesday reported that the necessary three-fourths ownership in the Peoples Gas Light Company and the Jersey City Gas Light Company, of Jersey City, N. J., and in the Hudson County Gas Light Company, of Hoboken, N. J., had been acquired by the United Gas Improvement Company, of Philadelphia. It is likely such majority interest has been acquired, but the belief cannot be strangled that some of the original shareholders in the Jersey City Gas Light Company, whose holdings amount to quite a good bit out of the remaining fourth, will not part with their stock at the purchasing Company's bid.——A further notice from the local newspapers (this quoting is from the New York *Evening Post*, of the 3d inst.) respecting gaseous matters in general, relates to the wonderfully weird doings of the composite Mayor of Toledo, Ohio, Mr. Jones, in connection with the natural gas plant of that city. The news, as per *Post*, is: "The question of the sale of the Toledo natural gas plant has come to a sudden close, a contract having been made with Charles D. Hauk, of New York, whereby he is to build a plant for the city to cost $250,000. Mr. Hauk agrees to give the city as much gas as needed at 25 cents per 1,000 cubic feet. He also agrees to sell the plant back to the city at the end of two years. The plant is to be in running order in 60 days." And that's all Jones knows about the gas business—for publication!

How the Volta Exposition Was Destroyed.

The *Electrical World* says that some details have reached this country as to the manner in which the interesting Volta Centennial Electrical Exposition at Como, Italy, was destroyed on July 8. It appears that flames were discovered in one of the galleries of the silk department at 10 o'clock in the morning, in the neighborhood of one of the large electrical machines belonging to the exhibit of the royal navy, which was in operation at the time, and a large flying spark from which is alleged to have been the cause of the disaster. All efforts made by the guard of firemen to quench the spreading flames were impeded by the wild panic among the visitors, and by the time the space was cleared the long gallery was in a blaze, the bales and loose pieces of silk, brocades, etc., catching the fire like tinder. In a few minutes the flames had reached the rooms of the adjoining electrical exhibit and the neighboring house containing the precious relics of Alesandro Volta. Every effort to rescue the priceless instruments and apparatus of the great inventor proved fruitless, and in a few seconds they were lost in the blaze. Meanwhile the fire had spread to all the remaining parts of the great buildings, and the bursting of the boilers in the machine department added a new terror to the scene.

In an hour's time the entire exposition grounds were one red-hot furnace. Despite the combined strength of the fire companies, and the deluge of water thrown on the flames, the fire raged all day. As soon as the ungovernable nature of the fire in the main buildings became evident every effort was directed to save those of the Exposition of Sacred Art, and of the Industrial Arts, separated from the electrical division by the large carriage drive running through the grounds. These efforts were more successful, and the flames were prevented from making any serious headway in this new direction. No lives were lost. A great part of the exhibits was not insured.

The exhibition was opened with great celebrations on the 20th of May, by King Umberto and Salandra, the Minister of Commerce and Agriculture. Messages of congratulation were sent from this country by the New York Electrical Society, the National Electric Light Association and the New York Electrical Exhibition. The concourse of visitors from all parts of the globe has been a constant and large one, and in the 49 days of its existence the exhibition had already showed itself to be a great success, when it was thus prematurely brought to such a disastrous end.

Besides the various instruments used by Volta in his many experiments, and which had been sent to the exhibit by the Institute of Science and Letters of Milan, the University of Pavia and the Civic Museum of Como, almost all Volta's autograph letters, his books, correspondence and a perfect library of works on electricity, from the days of its infancy to the present time, succumbed to the flames.

[Prepared for the Journal.]

Gas Pipe Engineering Topics.

By GAS ENGINEER.

In bending metal pipe it is very essential to get the scale and any gummy substance from the inside of the pipe, which is best done by blowing it out after bending. They should be blown out several times, and the pipe should at the same time be rapped lightly to loosen scales. If steam cannot be had for this purpose air will do. Some gas companies and gasfitters have had rather bitter experience through using a cheap pipe, for they find that in bending the pipe it splinters, the trouble being caused by steel being mixed with the iron. The best pipe is always the cheapest in the end. If possible tests of the pipe should be made to ascertain its adaptability for the work required. The most important compounds of iron for gas piping are red hematite, brown hematite, spathic iron ore, magnetite, pyrites and other bodies. With the exception of pyrites, all the above minerals are available for the manufacture of iron for pipe, but as a rule the iron master prefers to have only the oxides.

When a furnace is in operation and a mixture of the above substances (in suitable proportions as found by an analysis of the ore) is added at proper intervals, a "chemical reduction" of the oxides of iron to metallic iron and an oxidation of the carbon of the coal to carbon dioxide take place, while a certain amount of slag or cinder forms, both of which trickle down through the mass and accumulate at the lowest part of the furnace, known as the "crucible," and from which the melted iron is drawn off every few hours, through the lowest hole, running into a sand bed, and filling certain depressions, from which are taken, when cold, bars of iron known to the trade as "pig iron." Pig iron, then, is the result of the first process of obtaining metallic iron, but owing to the composition of this product it cannot be made use of to good advantage in the arts, consequently it must be refined or otherwise so treated that what is known as "merchant iron" is obtained; in other words, iron that can be forged and welded. In pipe made of mixtures of steel and iron splintering is liable to occur when bending or welding.

To determine temperature by fusion of metals, etc., use the following table:

Substance.	Temp.	Metal.	Temp.	Metal.	Temp.
Tallow.....	92° F.	Bismuth..	518° F.	Silver, pure....	1,830° F.
Spermaceti.	120° F.	Lead.....	630° F.	Gold coin.....	2,156° F.
Wax, white.	154° F.	Zinc.....	793° F.	Iron, cast.....	2,010° F.
Sulphur....	239° F.	Antimony	810° F.	Steel	2,550° F.
Tin.....	455° F.	Brass.....	1,650° F.	Wrought iron .	2,910° F.

When gas pipes are carried through water in tanks, as in dye houses, bleacheries and steam laundries, the metal often becomes coated with a hard scale difficult to remove, and it will be found that the addition of some caustic soda and steaming for some hours, according to the thickness of the scale, just before cleaning, will greatly facilitate that operation, rendering the scale soft and loose. Tannate of soda is a good preparation for general use, but in waters containing much sulphate it should be supplemented by a portion of carbonate of soda or soda ash. For muddy water, particularly if it contains salts of lime, no preventive of incrustation will prevail except filtration, and in almost every instance the use of a filter, either alone or in connection with some means of precipitating the solid matter from solution, will be found very desirable.

The Testing Pump.—If the suction is poor on the up stroke of the piston of the air test pump, and there is no blow at oil cup on downward stroke, it is safe to conclude that back leakage into the lower end is occurring from main reservoir of the pump itself back into the cylinder, and that it may be due either to leaky discharge valves or because of air passing around bushings. Practice will enable this being much quicker done than told. In testing the pump it should be determined that piston rod packing is in good condition. When a pump seems to run too slow or blow bad, try it with an exhaust pipe disconnected, using a short piece of pipe bent so as to turn the force away from the jacket. This will indicate any obstruction in the exhaust pipe, and the absence of or a defective dry pipe, and will demonstrate and assist in locating any blow in the cylinder.

To locate trouble where suction is not good stop the pump, open oil cup and note whether air blows out of cup. If this occurs it indicates leakage back from the main reservoir. To determine this stop the pump, and if the latter is the case the blow will continue after the piston has come to rest.

Where bottom head has a plug removing the plug will indicate whether back leakage is taking place into lower end of cylinder. Or

when that is not possible, with a piece of wire lift the lower receiving valve. This will render unnecessary the removal of the plug.

Taking Temperatures.—The temperature of the contents of gas pipes may be taken with thermometers specially designed to fit into a one-half inch hole drilled in the pipe, or such a hole may be drilled and a plug screwed therein, the center of which has been drilled to form a cup. This cup is filled with oil, and a thermometer set in the oil will give the temperature of the gases surrounding the plug. The matter of the thickness of the metal will make no appreciable difference.

These testing devices can be cheaply made, and a thermometer, scaled by degrees to 400, can be purchased for a dollar, and its accuracy assured by placing it in a kettle of water that is violently boiling with the cover off. The temperature should then show 212°, if accurate. The temperature of the feed-water should be taken at frequent intervals.

The temperature of the up-take can also be taken by filling a pot with cylinder oil, which may be lowered into the center, the thermometer being set in the oil pot. The pot is withdrawn and the thermometer read. Or a pyrometer may be used.

Care of Gauges.—To determine the condition of gauges a test gauge should be attached. As some cylinders are so located as to make it impossible to connect a test gauge to the head, a tee should be placed in a convenient place in pipe leading to cylinder. Should any repairs be necessary, it is desirable that parts be sent to general repair shop, thereby insuring the proper adjustments and arrangements of the structural parts. The parts of one gauge should never be exchanged for those of another. Where, owing to the shape of the plugs, as in round and half-round, it is not possible to grind by use of the machine, what are known as hard stones are employed, the work being accomplished by hand instead of machine, the result being the same.

As to the effective lubrication of the frictional parts of the gauges, I have experimented with various oils, and have concluded that good results can be had from almost any high-grade oil, providing it has sufficient body. Valve oil does not always imply good oil. Some engine oils are of heavier body than some poor valve oils. Good valve oils are preferable to good engine oils for lubricating the cylinder and other parts of the test gauge. Pouring a drop of oil to be examined on a well cleaned glass plate placed at an incline, and noting the time it takes for the oil to reach a mark on the bottom of the inclined plane, will indicate to some extent the viscosity and clinging power of one oil over another. By increasing the temperature, by means of an alcohol lamp or otherwise, we can likewise judge as to the uniform consistency an oil possesses over others, or compared with like tests made with oils of proved efficiency.

Packing Clay.—Packing clay as used by gas pipe fitters is mixed with such substances as fragments of rock, quartz, feldspar and mica, with carbonate of lime, magnesia, the oxides of iron and potash. The gritty particles reduce the plasticity of paste composed of clay and water, and diminish its chances of sticking. The iron stains the wet clay, the lime decomposes magnesium and zinc chlorides, destroys the antiseptic properties of the latter, and, by forming calcium chloride, alters the composition. The following is the composition of the commercial articles:

	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Silica	46.32	47.38	46.47	46.104	48.01
Alumina	38.74	38.42	0.03	36.891	36.72
Oxide of iron	0.27	0.74	0.38	0.329	0.44
Lime	0.36	0.14	trace	0.485	0.32
Magnesia	0.44	trace	trace	0.237	0 03
Alkalies	1.10	1.23	1.24	1.869	1.72
Water	11.77	12.09	11.88	14.085	12.76
	100.00	100.00	100.00	100.00	100.00

The Leads.—A pure lead for pipe connections should answer to the following tests: It is completely soluble without effervescence in dilute sulphuric acid. No other white pigment will answer to this test, and any considerable effervescence would indicate adulterations with white lead or whiting. A slight effervescence may be neglected, it being due to the presence of a small quantity of zinc carbonate, the formation of which during the process of manufacture cannot always be avoided.

If the samples show signs of being adulterated it will best be treated with hydrochloric acid and boil, effervescence indicating white lead and whiting. Any crystals forming out of the solution on cooling show the presence of white lead or sulphate of lead; any residue left after treatment with acid would show barytes, gypsum or china clay. Which of these bodies is present can be ascertained by the application of special tests.

Differential Rates as Between Consumers of Gas for Purposes Other than Lighting.

[A paper read by Mr. Thomas Newbigging, of Manchester, England, at the Thirty-sixth Annual General Meeting of the Incorporated Gas Institute.]

This subject has been treated before, more than once or twice, at different meetings of gas engineers. It appears to be necessary to resuscitate it periodically, in behoof of those having short memories; and, if possible, to prevent the introduction on the one hand, or the perpetuation on the other, of a system which not only has nothing to recommend it, but is objectionable from every point of view. I will not burden my remarks with many figures. Those who care to pursue the subject further, and are fond of statistics, can supply the figures for themselves. I prefer to make my paper conversational rather than arithmetical. Besides, I have the fear of commentators before my eyes. These dry (not to say prosy) mechanical disquisitions do not go down with our journalistic critics. The popular treatment of a subject in a suggestive rather than in an exhaustive (or exhausting) manner is what is desired in these stressful times, especially in the Metropolis and under the hot sun of Mid-June.

I desire to enter my strong protest against an injustice which is, I will not say widely prevalent, but is gaining some ground in the gas industry, and which in its outcome must tend to do it injury. There are in the United Kingdom 57 gas companies and 32 local authorities owning gas works, who sell gas for cooking, heating and motive power at a lower price per 1,000 cubic feet than the same gas for lighting purposes. Consequently, as I hold, there are in the United Kingdom 57 gas companies and 32 local authorities owning gas works, who are dealing unfairly by their gas-for-lighting consumers. I will endeavor to prove this simple proposition. Several of these sell the gas to the gas-for-cooking-heating-and-power consumers at cost price, if not at an actual slight loss; and on the plea, as one manager expressed it, that "it is a good thing to have customers burning gas all the day."

This reminds me of the old lady who kept a shop, bought eggs at 12 for 6d. and sold them at the rate of 13 for the same money. On being expostulated with she admitted that there did not seem to be much profit on the transaction, but at least it was "turning the penny." Possibly it is the quantity that pays, as another illogical trader explained; or is it an exemplification of the ability of some people to live by their losses? This day consumption, if not viewed from a common-sense standpoint, is a mere fetish; worshipped without intelligent knowledge.

Encourage a day consumption by all proper means, but not at the cost of inflicting an injustice. Do it by reducing the price of the gas all round, and not by favoring one customer to the disadvantage of another. The gas which both classes of consumers use is one and the same. Its prime cost is the same whether it be used for lighting or for purposes other than lighting. A statement of that kind, indisputable as it is, ought to settle the question.

The assumed advantage of the day-gas consumer is that he burns the gas when the mains would otherwise be lying idle and unproductive; and so there is a saving of capital by the more complete utilization of that on which capital has been expended. But there is a fallacy here. Most of the so-called day-gas consumers are not so, pure and simple. Much of the consumption for heating, cooking and power takes place during the lighting hours both morning and night, and not exclusively during the daylight hours. There is thus an over-lapping which vitiates the assumed special advantage of the day custom, inasmuch as the mains have to be of capacity sufficient to serve for the night and a portion of the so-called (but mis-named) day consumption. "But," says one, "seeing that our day-gas consumer is also a night-gas consumer, he should have special consideration: Codlins, in this case, is our friend, not Short."

Admitting that contention for a moment, what special consideration does Codlins get in the rate differential? Surely, little or none. The difference in price for the two classes of consumption is simply putting into one pocket money which has been abstracted from the other. If the balance is not rectified in that way, then it comes from the pocket of Short. But look at the inconsistency of the practice. In the winter months, as I know from experience, a very considerable consumption takes place in the lighting of ordinary gas jets for the warming of rooms in cold weather. A day-gas consumer of this kind receives no special consideration whatsoever from your advocates of the differential rate; and for the reason that he chooses to warm his room by means of an ordinary gas jet, instead of with a gas stove or an open gas fire.

It is to be noted as a very significant circumstance that, with but two or three exceptions, the 89 companies and local authorities who resort to this unfair dealing are dear gas for-lighting sellers. Of the lot, only 7 of them charge gas for lighting below 3s. per 1,000 cubic feet. That, of course, is what might be expected under the circumstances. The reason is obvious, and it enforces my argument: A high lighting price is maintained in order to keep down the price to the other favored class of consumers. Was ever anything more obnoxious and unfair? Who, after all, is the gas manufacturer's best customer? Which is the goose that lays the golden eggs? Unquestionably it is the gas-for-lighting consumer. Taking him all round, he is the largest consumer; of that there cannot be a dispute. It is mistaken judgment, where it is not sheer ingratitude, to charge our oldest and best consumer a higher price than the other. Competition with oil and electricity is greatest in the lighting department of our business, and yet there are those who handicap their best horse by putting a heavier charge upon him.

This handicapping of the gas-for-lighting consumer, looked at aright, will be found to be at variance with all sensible business methods. No merchant would think of charging a customer a higher price for goods by reason of his coming every day to buy at those hours when he (the merchant) was busiest. On the contrary, his song would be, "Let 'em all come;" and, if need be, he would enlarge his staff and his premises to meet his customers' needs and convenience. Again, say you go into a shop and ask for a pound of butter. The shopman in answer might say (imitating the way of some gas men): "This butter is 1s. a pound if you intend to butter loaf bread with it; but if you are going to use it for buttering tea cakes it is 1s. 2d. a pound." If your indignation did not get the better of you, you would laugh at the fool of a shopman for his absurdity, and ask if he was quite *compos mentis*.

If there is to be a differential rate, let it be to the large consumer irrespective of the particular use to which he puts the gas. Be content to let him make a church, or a mill, or a haystack of it, so long as he pays for what he gets. That kind of differential rate is quite legitimate; provided that judgment is exercised in determining its fair proportion.

I say nothing about the complication of having two meters and two sets of internal fittings, though that is objectionable enough. What I protest against is the injustice that is being done to consumers who happen to use gas for lighting only, and who are virtually compelled to contribute towards the supply of other consumers who use the same gas for a purpose other than lighting.

Let me give a concrete example: A Company is now in Parliament seeking, among other things, for power to supersede a clause in a former Special Act which provides that the charge for the public lighting shall not be more than the lowest charge to any other consumer. With the blindness which characterizes much of our legislation, the Bill has passed one House, giving the Company power to lower its charges to heat-and-power-gas consumers without at the same time reducing the charge for public lighting.

The result in this case will be, if the Bill goes through, that a peddling consumer who burns a few thousand cubic feet for cooking purposes will have his gas at a lower rate than an important Corporation whose consumption for lighting amounted last year to no less than 171 million cubic feet. The Secretary of the Company in question, in the course of giving evidence, stated that he saw his way to the Company selling gas to consumers for heating, cooking, and power at 6d. per 1,000 cubic feet below the present selling price.

I have made an analysis of the Company's revenue account for the year 1897 (the last account to which I have had access), and I am enabled to show that there would be a positive loss of revenue in adopting the proposed differential rate as between the two classes of consumers. It will be seen from this statement that the surplus left from the revenue, after making all payments for coal, working expenses, and capital charges, is only 0.45d.—less than one halfpenny per 1,000 cubic feet of gas sold. It is obvious, therefore, that any reduction in the price to those consumers who use the gas for cooking, heating and motive power, must result in a deficit of revenue, which will have to be counterbalanced by an increase in the price to gas-for-lighting consumers, unless (which is not to be thought of) the company elected to sacrifice part of its dividend. It is further obvious that any reduction in price which may be made to the consumers of gas for heating, cooking and power, can only be accomplished by relieving them of their fair share of the fixed expenses, and throwing these (in addition to their own) upon the gas-for-lighting consumers.

The analysis is as follows:

		Per 1,000 Cubic Feet of Gas Sold.
Receipts—		
Net gas rental		27.90d.
Meter and stove rental		0 83
Miscellaneous receipts		0.07
Coke		3.94
Breeze		0.25
Tar		1.88
Ammonia		1.55
Total receipts per 1,000 cubic feet of gas sold		36.42
Payments—		
Coal	14.09d.	
Working expenses	13 83	
Total payments for manufacture and distribution, per 1,000 cubic feet of gas sold		27.92
Gross profit		8 50
Capital Charges—		
Interest on loans	1.40d.	
Maximum dividend	7.00	
Total capital charges per 1,000 cubic feet of gas sold		8 40
		0.10
Received—Interest on invested funds		0.35
Surplus		0 45

Then how is the reduction to be brought about without either raising the price to the gas for lighting consumers or reducing the dividend payable to the shareholders? Clearly, reliance is being placed on the natural growth in the Company's business to shortly yield the needed surplus. No attempt will be made at a reduction until the increment arising from this natural growth has produced such a balance of profit as will admit of a tangible reduction being made to the favored class of consumers. In other words, the increase in the profits beyond what is required for working costs and capital charges, due to expansion in the Company's operations, and to which expansion the gas-for-lighting consumers will have contributed their share, is mortgaged beforehand for the special benefit of the other class. This being so, Peter is robbed to pay Paul; for it is evident that the gas for-lighting consumers may whistle for their share in the reduction to which they are justly entitled, and which they would get provided a uniform rate were charged to all consumers alike.

Thus we see that there are two ways of robbing a man. He may be robbed: (1) Directly, by abstracting the cash from his pocket, or (2) he may be robbed indirectly by his being prevented from reaping the advantage which is his due, and which, but for an unfair action, he would have reaped. It cannot be too often repeated, therefore, that differential rates as between the different classes of consumers are grossly unfair, and that the principle when looked into cannot be defended. It is a mere accidental circumstance that one consumer uses gas for lighting and another for heating and power. They are both consumers of one and the same gas; and they should each in fairness contribute their share, in proportion to their consumption, to the cost both of manufacture, distribution and capital charges.

No doubt a day consumption reduces the working expenses and so cheapens the cost of production; but that being so, how much more must the heavy night consumption do the same, because here is a complete utilization of the capacity of the mains, whereas the other is only partial. The absurdity of the claim to special advantages for the day gas consumer has only to be stated in this way to be perceived. As a matter of fact, the effect of any consumption, whether by day or night, is to utilize capital and modify the working expenses; but where would the day consumption as a dividend earning instrument be without the night consumption? The cheapening process, then, should extend to all gas consumers alike, and not to one favored set. Take the case of the shopkeeper: In scores of instances he sets up a brilliant illuminating display far in excess of what he needs for the mere lighting of his premises. He does this by way of advertisement; and yet under the objectionable regulation he is not entitled to, or at least he does not receive, the special reduction. Compare him with the man in the next street. The latter has the electric light throughout his premises, with the exception of one gas jet in the cellar, and a gas griller in the kitchen. These are supplied through two separate meters; and by the differential scale he gets his paltry modicum of gas at a price lower than the other who burns, it may be, fifty or a hundred times more.

These considerations accentuate the unfairness of differentiating the price, as between the two classes. In point of fact, as I have already said, the adoption of differential rates of this character prevents the great bulk of the gas consumers from reaping the benefit of a growing business. Again I urge, if there is to be a differential rate let it be for quantity, not for class consumption. Here is legitimate ground for some reasonable concession in price; and it would apply, of course, to gas usage of every kind.

One flagrant instance of the abuse to which differential rating lends itself has recently come under my notice. A certain board of directors consists of men who use gas somewhat largely for motive power. They have found it of advantage to avail themselves of the system, and have accordingly reduced the price for gas engine purposes to a point which leaves little or no profit on the consumption. The company nevertheless pays its maximum statutory dividend. It needs not any special penetration to settle what other class of consumers is mulcted to pay such dividend, not only on the capital expended on their own behalf, but also on that which has been spent for the supply of the other. This is sheer robbery, of course. But, indeed, all class differentiating in price is robbery less or more.

As more particularly bearing on the question of public lighting, it should be remembered that, like the consumption of gas in the daytime, the public lamps, in most towns, burn gas during many hours in the night time, when but little gas is being used for other purposes. For that reason alone it is but reasonable and fair that the gas so consumed should be charged for at a rate not higher than is charged to any other consumer.

If any of you, not having adopted this unfair kind of differential rating are thinking about doing so, pray abandon the idea. Deal justly by your consumers all round. Some managers are smarting under the infliction of the differential rate which has been introduced by their respective boards contrary to their advice. Others again, having advised, or having acquiesced in, the adoption of the system, cannot well recede from that which they have previously recommended. So, like the fox without a tail, they try to make a virtue of necessity, and continue to countenance and recommend the practice. But my advice, even to them, is to abandon a bad system, and gradually, as occasion admits, level down the price to the gas-for-lighting consumers. It is never too late to mend.

The Protection of Low Tension Wiring Against Dangerous High Potential Currents.

[A paper read by Mr. W. J. Plews, at the last meeting of the Canadian Electrical Association.]

All persons in connection with electrical supply companies, especially in lighting service by alternating currents, have long recognized the necessity of some reliable apparatus to prevent low tension service wires inside buildings from becoming a possible source of danger to human life, or as regards fire, in event of contact with high tension conductors. That this condition often exists, and that the danger therefrom can hardly be overestimated, is a well known fact to all electricians who have had experience with alternating current systems.

Some years ago the principal element of danger was the liability of transformers to break down between the primary and secondary coils. Of late, however, conditions have changed considerably, the most recent types of transformers being a vast improvement on the older ones. While the contingency as regards transformers is not now so great as in former years, the change in the system of secondary distribution, involving as it does the use of large secondary units and a network of wires covering a great area, has given rise to another and, if anything, a more important element of danger—namely, the increased liability of accidental contact between high and low tension conductors. This change in secondary distribution has been rendered necessary from an economical standpoint, and as it is not at all likely that anyone will revert to the old system, the proper course seems to be the protection of individual equipments.

The contingencies previously mentioned have proven a frequent cause of fire and in some instances have resulted in fatal accidents. Recognizing these dangers, various earthing devices have been contrived to cope with the difficulty. It seems, however, that the idea has been to afford protection from the breaking down of transformers only, by means of blowing the primary fuses, the inventors apparently not having taken into consideration the contingency of accidental contact between local and foreign conductors, whereby a large volume of current at a high potential may flow over the secondary apparatus and destroy both it and the protective device, in which event the protective device itself would probably become a source of fire.

Several of the cases which have come under the observation of the writer, wherein conditions as mentioned have existed, have been of such a nature that any earthing device depending upon the blowing of a fuse for its action would have been a positive fire hazard. One instance in particular was a cross between a fallen secondary and a trolley wire. In this case had there been any device of the type mentioned a volume of current would have flowed through the apparatus sufficient either to destroy it or blow the secondary fuses; this latter occurring, it is reasonable to assume that the high tension current would have maintained an arc across the terminals of the cutout (one such as generally used for low tension wiring) and produce disastrous results.

As far as the writer's knowledge extends, the principle, common to all safety devices of this nature heretofore developed, has been to disconnect the local system from the source of danger by means of blowing fuses. This principle appears to be radically defective, the blowing of a fuse under such conditions being an uncertain element, attended at times with undesirable results.

In an apparatus designed to protect local low tension systems from currents of higher potential than they are constructed for, or expected to carry, it would seem more rational to employ a device that will automatically and instantaneously disconnect the high tension current from the low tension system to be protected, without depending upon the uncertain action of fuses. It is also believed that a device of this nature should be one in which the amount of current necessary for its successful operation is a known quantity, and that this quantity be as small as possible, so as to avoid dangerous arcing.

Considering the matter from this point of view, the writer believes that an apparatus can be constructed which will embody the desirable characteristics, and it is to this possibility that your attention is respectfully invited.

One form of such an apparatus, which is on exhibition here, is similar in action to a double pole knife switch, and is so constructed as to automatically open the circuit instantaneously whenever the low tension wiring is brought into connection with conductors charged with dangerous high potential currents, either through a breakdown in a transformer or a cross between secondary and primary or other high tension conductors.

The great advantage claimed for this apparatus is, that no matter how large the volume of current may be, only a small fraction is required to operate the device, and this is only for an infinitesimal period of time, the device in opening disconnecting both the safety apparatus and the interior wiring from the outside source of danger. Another advantage is in the fact that the device provides special facilities for rapidly testing the local system for grounds, without the use of other apparatus.

During the past few years many fires have originated from high potential currents accidentally traversing secondary systems and breaking down the insulating joints which intersected the junction between fixtures and gas pipes. From the manner in which first class electric light wiring is installed at the present day, it would seem impossible for a current at a potential of, say, 2,000 volts, to cause a rupture between secondary wiring and ground, and the writer's experience leads him to the conclusion that if the so-called insulating joints properly performed their function, fires from this cause would be extremely rare.

If on the other hand low potential systems are so arranged that there is no chance for high potential currents to rupture to ground, there remains the danger of some person receiving a fatal shock while handling the apparatus.

In view of these facts, it would seem advisable to equip all low potential systems which are exposed to the contingencies herein mentioned with an automatic device that in time of need will operate effectively.

The Coke Industry of 1898.

The United States Geological Survey has completed its report upon the production of coke in the United States during 1898. The constantly increasing consumption of this important product for metallurgical purposes gives a special interest to the following abstract:

"Recent developments in the construction of by-product ovens where the by-products of gas, tar and ammonia are given equal importance with the coke have rendered it necessary to depart from the previous rule of the survey to eliminate statistics referring only to coke obtained in the manufacture of illuminating gas. So long as the coke is the

primary product, and particularly when the coke is used for metallurgical purposes, its comprehension in these reports is necessary and proper.

"The completion of the bank of 400 ovens at Everett, near Boston, Mass., has been attained as this report goes to press. The product from these ovens while not being primarily blast furnace, foundry or other metallurgical coke, will be the output from Otto-Hoffman ovens similar to those at Johnstown and Otto, Pa., and although made from coal to be drawn from Nova Scotia mines may be properly considered as coming within the scope of these reports and will be so included. As the by-product coke industry develops and extends, as it is sure to do, the scope of this report will necessarily be enlarged. In anticipation of a demand for information as to the amount and value of gas and other products obtained from coal which are produced in the United States the survey has collected from the gas companies and by-product coke producers the statistics of the production of gas, tar, ammonia and gas house coke during 1898 and these are presented separately.

"The coal used in coking in the United States is drawn from all five of its great bituminous coal fields, the Appalachian, the Central, the Western, the Rocky Mountain and the Pacific Coast. The Appalachian field is the great source of supply, for while there are 13 coke producing States outside the Appalachian field to 9 within it the output outside of the field in 1897 was only 546,954 short tons out of a total product of 13,288,984 short tons, and in 1898 the product outside the field was 660,824 tons out of a total of 16,047,209 tons. From this it will be seen that the States in the Appalachian coal field contributed more than 95 per cent. of the total coal product of the United States.

"The statistics of the production of coke in the United States show that the output in 1898 was more than 20 per cent. in excess of any previous year in the history of the industry. Exclusive of the coke produced in gas house retorts, and which is not considered in these reports, the coke product of the United States in 1898 amounted to 16,047,209 short tons, against 13,288,984 short tons in 1897. The increase in the product in 1898 as compared with the preceding year was 2,758,225 short tons, or 21 per cent. Prior to 1898 the maximum yearly product was obtained in 1895, when the output amounted to about 45,000 tons more than that of 1897. Some idea of the rapid growth of the coke making industry in the United States may be obtained from the statement that the product in 1898 was 7,500,000 tons, or nearly 90 per cent. more than that of 1888, and nearly five times that of 1880, the first year of which there is any record.

"Notwithstanding the fact that the enormous production in 1898 was induced by a demand which was for a greater part of the year at least fully up to the supply, there was a decline in values, the average price per ton falling from $1.66 in 1897 to $1.59 in 1898. The aggregate value showed an increase from $22,102,514 in 1897 to $25,586,699 in 1898, a total gain of $3,484,185, or 16 per cent., as compared with 21 per cent. increase in production. All of the more important coke producing States share in the declining price. In Pennsylvania the average price per ton declined from $1.53 to $1.50, in West Virginia from $1.31 to $1.26, in Alabama from $2.14 to $2.03, in Virginia from $1.40 to $1.32, in Colorado from $2.92 to $2.59, and in Tennessee from $1.81 to $1.63 These six States named in the order of their producing rank contributed 15,703,907 short tons, or 98 per cent. of the total product in 1898 Tennessee, the smallest of the six in producing importance, had the product in 1898 of 394,545 short tons. Pennsylvania's production increased 1,748,378 short tons, or 19.5 per cent.; West Virginia increased 452,405 short tons, or 30.7 per cent.; Alabama increased 220,003 tons; Virginia increased 177,094 tons, or 50 per cent.; Colorado 132,155 tons, or 38.57 per cent., while Tennessee's increase was only 7 per cent., or 25,776 tons. It must be borne in mind that in this statement the production of New York is included in Pennsylvania, from which the coal is drawn, and Colorado includes the production of Utah, but in neither of the included States was the production sufficiently large to affect the totals or percentages.

"The number of ovens built increased from 47,668 in 1897 to 48,447 in 1898. At the close of 1897, 545 ovens were in course of construction, including 120 Semet-Solvay by-product ovens building at Ensley, Ala.; at the close of 1898, 1,048 ovens were in course of construction, including 400 Otto-Hoffman by-product ovens at Everett, near Boston, Mass., and 100 or more of the same type in the Allegheny Mountain district (Johnstown), Pennsylvania. The number of by-product coke ovens in existence at the close of 1898 was 550, including 280 Semet-Solvay, 180 Otto-Hoffman and 90 Newton-Chambers, 30 of the last, however, not being operated as by-product ovens, leaving 520 active. In 1897 the number of active by-product ovens in existence was 280. On December 31, 1897, 195 by-product ovens were building, all of which were completed in 1898, and the close of the latter year saw 500 more in course of construction, 400 of which were put into operation in the summer of 1899.

"The following figures show the production of coke in the leading fields of Alabama, Colorado, Pennsylvania, Tennessee, Virginia and West Virginia.

"*Alabama.*—Establishments, 25; ovens built, 5,456; ovens building, 100; coke produced, 1,663,020 short tons; value, $3,378,946; yield of coal in coke, 59 per cent.

"*Colorado.*—Establishments, 12; ovens built, 1,253; ovens building, 3; coke produced, 474,808 short tons; value, $1,230,428; yield of coal in coke, 59.1 per cent.

"*Pennsylvania.*—Establishments, 151; ovens built, 27,157; ovens building, 292; coke produced, 10,715,302 tons; value, $16,078,505; yield of coal in coke, 65.7 per cent.

"*Tennessee.*—Establishments, 15; ovens built, 1,949; ovens building, 40; coke produced, 394,545 tons; value, $642,920; yield of coal in coke, 54 6 per cent.

"*Virginia.*—Establishments, 6; ovens built, 1,564; ovens building, none; coke produced, 531,161 tons; value, $699,781; yield of coal in coke, 62 per cent.

"*West Virginia.*—Establishments, 87; ovens built, 8,659; ovens building, 161; coke produced, 1,925,071 tons; value, $2,432,657; yield of coal in coke, 61.2 per cent.

"*Total of All States.*—Establishments, 342; ovens built, 48,477; ovens building, 1,048; coke produced, 16,047,209 tons; total value, $25,586,699; average yield of coal in coke, 63.6 per cent.

"The number of firms engaged in the industry in 1898 was 284, an increase in 15 years of only a little more than 20 per cent., whereas the number of coke ovens has increased 140 per cent. In the same period the coke product has increased over 200 per cent., illustrating very clearly the tendency of carrying our large industrial enterprises under one management rather than to distribute the business among the large number of smaller concerns. In 1883 the average number of ovens to each firm or corporation was 79, and the average yearly production by each firm about 23,600 tons. In 1898 the average number of ovens to a firm was 171, and the average production per firm 56,500 tons, showing that while the number of firms has increased only about 20 per cent. in 15 years, the average number of ovens to each has increased 120 per cent., and the average production per firm 140 per cent.

"Of the 284 firms and corporations from whom reports were received in 1898 53 produced no coke. The total number of ovens owned by these 53 firms was 2,686, an average of 50 ovens each. One of these firms owned 200 ovens, and 11 others owned between 100 and 150 each. From this it is seen that only one of the idle firms owned as many as the average number of ovens to a firm in 1898, and it appears that nearly all of the idle firms were small producers. In addition to these there were 428 ovens idle, which were portions of plants that produced coke in 1898. All of these latter were in Pennsylvania The total number of ovens idle in 1898 was 3,114, which deducted from the whole number of 48,447 leaves 45,333 ovens in active operation during the year. These, distributed among the 231 active firms, made an average of 196 ovens to each, as against an average of 50 for the idle ones.

"Of the total number of ovens 3,114 were not operated in 1898. The idle ovens were distributed as follows: Pennsylvania, 1,531, or 5.5 per cent.; West Virginia, 568, or 6.6 per cent.; Alabama, 286, or 5.25 per cent.; Ohio, 190, or 43 per cent.; Kentucky, 150, or 51 per cent.; Tennessee, 128, or 6.6 per cent.; New Mexico, 76, or 40 per cent.; Montana, 100, or 33 per cent.; Indiana, 40, or 43 per cent.; Colorado, 30, or 25 per cent.; Kansas, 9; Virginia, 4, and Missouri, 2."

Elements of Design Favorable to Speed Regulation in Plants Driven by Water Power.

[From a paper read by MR. A. V. GARRATT, at the Boston Meeting, Am. Inst. Electrical Engineers.]

The writer has found, in a practice amounting to something over 90,000-horse power of water wheels in the last four years, that with good water wheels properly set and rigged, and controlled by governors of suitable design, the speed may be held within 5 or 6 per cent. of normal upon circuit breakers opening under full load, and that the speed may be brought back to normal in from 5 to 15 seconds, depending upon the amount of kinetic energy in the rotative parts and moving water column. With incandescent loads of the ordinary type, a recording tachometer will show a practically straight line. With ordinary electric railway loads, speed variations of about 3 per cent. as at

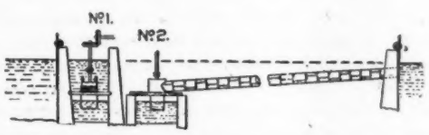
maximum may be expected. These figures are not intended to be of unusual application, but are for simply showing the present state of the art. It should here be added that governors can be obtained which will permit any number of independent water wheel units driving electrical units connected in parallel to be operated with perfect convenience and safety. It should also be noted that in the case of alternating units it is perfectly easy to get them at speed and in step for multiple connection without undue delay, and without any hand regulation.

These desirable ends cannot, however, be obtained to their fullest extent if the general design of the hydraulic portion of the plant is bad. We will now consider those things, aside from the governor itself, which tend to make the regulation good or bad.

As a preliminary thought, let us consider for a moment that the problem is quite different from steam engine governing, which naturally comes to the mind in this connection, for the reason that water is heavy, practically non-compressible or non expansive, and must be transmitted to the water wheel in large volume and at low velocity; while steam is light, highly compressible and expansive, and may be transmitted to the engine in small volume and at high velocity. From this it follows that the engine valves are small, light, and may be perfectly balanced, while water wheel gates are necessarily large, heavy, and are frequently, although often unnecessarily, out of balance. The inertia of the steam may be always neglected, the inertia of the water must be always considered.

The problem of governing a water wheel, then, involves moving large volumes of a heavy, practically incompressible fluid, acted on by the force of gravity alone, and of moving ponderous gates; and this must be done with absolute promptness. Also adequate provision must be made for the momentum and inertia of the moving water and mechanical parts.

Suppose we have two water wheels operating under the same head, which we will assume to be 9 feet. You will observe that although the head is the same in both cases, one wheel, which we will designate No. 1, is set in an open flume of ample size, while the other wheel, which



we will designate as No. 2, is in a closed flume connected to open water by a long closed pipe which is nearly horizontal. The behavior of these two wheels when operating under variable load, is entirely different.

Let us assume, for the purposes of argument, that the efficiency of the wheel is the same at all stages of gate, and that the amount of water which passes through the wheel is proportional to the gate opening, and that the power of the wheel is proportional to the amount of water which passes through it under constant pressure. Now, if the wheel is operating at full gate and half the load is suddenly thrown off, and the suitably designed governor attached to the wheel promptly shuts the gates so that only one-half as much water can pass as when the wheel was at full gate, it is evident that the speed will remain comparatively constant.

Let us see if this will be the case with wheel No. 2. If it is operating at full load, and half the load is instantly thrown off, and the governor promptly shuts the gates so that only half as much water can pass, it is evident that the velocity of the water in the closed pipe must be reduced one-half.

If we assume that the water in the pipe weighs 1,000,000 pounds, and has a velocity at full head of 4 feet per second, its energy $= 1{,}000{,}000 \div 32.2 \times 4^2 \div 2 = 248{,}440$ foot pounds; and if the water velocity at half load is 2 foot pounds per second, then the energy $= 1{,}000{,}000 \div 32.2 \times 2^2 \div 2 = 62{,}110$ foot pounds, and the difference between these two amounts of energy, $248{,}440 - 62{,}110 = 186{,}330$ foot pounds, must be expended upon the water wheel before the water velocity is reduced to 2 feet per second.

If it were expended in one second it would $= 186{,}330 \div 550$-horse power, but this is a little quicker than we would expect to do in practice. Suppose we slow up the water column in two seconds, then the energy expended $= 186{,}330 \div 550 \times 2 = 169$-horse power for two seconds. The above value of horse power would not hold strictly true unless the rate at which the gate closed was proportional to the rate at which the water column slowed up; but the total foot pounds expended on the wheel would be as above stated.

It is evident that the above amount of work done upon the wheel while the water column is slowing up, would tend to make the speed of the water wheel run high if the governor only half closed the gates. In fact, the governor would have to set the gates much nearer closed than one-half; or, to speak more accurately, the governor would, at each instant of time, have to hold the gates at such a position that the power developed by the wheel, due to the working head plus the instantaneous value of power being developed by the slowing water column, equalled the load upon the wheel.

This might be found to be quite unfeasible, for the pressure developed on the closed pipe and wheel case might be dangerous, or the gate might be too ponderous or too badly rigged to permit of the requisite promptness of motion.

The maximum pressure which would be developed at any instant of time at the water wheel, would be an impossible thing to calculate without knowing a great deal more about the venting areas and time ratio of closing them than can ordinarily be found out in practice. All that can be predetermined is what may be called, for want of a better term, the time average pressure. This can easily be determined as follows:

Let P = the time-average pressure.
L = the length of the closed flume in feet.
V = the water velocity in feet per second.
T = the time in seconds in which the water velocity is arrested.
K = the area of a square inch expressed in square feet = .00694.

Then—
$$P = \frac{K \times 62.4 \times L \times V}{32.2 \times T}. \qquad (10)$$

It will be observed that $\frac{K \times 62.4}{32.2} = .01324$ is a constant, call this K_1 and the formula becomes—

$$P = \frac{K_1 \times L \times V}{T}. \qquad (11)$$

Applying this to the flume we have been discussing, in which—

$$L = 300;$$
$$V = 2;$$
$$T = 2;$$

we have—
$$P = \frac{.01324 \times 300 \times 2}{2} = 3.97.$$

As a water column 1 foot high exerts a pressure of 43 pounds per square inch, it follows that a pressure of 3.97 pounds per square inch represents a head of $3.97 \div .43 = 9.2$ feet. In other words, if the pressure on the wheel could have been kept constant all the time the water column was slowing up from 4 feet per second to 2 feet per second, the wheel would have been working under $9 + 9.2 = 18.2$ feet of head, instead of under 9 feet of head as it should have been.

From experience we know that it is impossible to close the water wheel gates at such a rate as to keep the pressure constant, and as a matter of fact, during some portion of the two seconds the water pressure would have been greatly in excess of 3.97 pounds per square inch above normal, with a correspondingly large disturbance of the speed.

We may note a curious fact in this connection. With a water wheel set like No. 2, working at nearly full gate, and if under these conditions a large portion of the load is instantly thrown off and the governor is of unsuitable design and does not compensate for the kinetic energy of the slowing water column, it may be found by experiment that the speed will run higher than though there were no governor at all. This is for the reason that for an interval of time the wheel is working under light load and a greatly increased head, and there is, consequently, greatly increased speed; or, we may say the amount of energy applied to the wheel under the increased pressure, even though the gate areas have been somewhat reduced by the governor, is greater than would have been the case had the gates not been moved at all.

The first remedy which suggests itself is to place large relief valves near the wheel case, so that they will open and let the water escape if the water much exceeds the static head. This would help matters somewhat upon load suddenly going off, but would it help matters upon load suddenly going on? Let us examine this matter.

Suppose the wheel is working at half load with the water column moving at a rate of 2 feet per second, and the whole load is instantly thrown on the wheel. The governor will promptly open the gate wide, but the water wheel cannot develop its whole power until the water column has attained a velocity of 4 feet per second. To gain this extra 2 feet per second, the water column must have expended upon it the same amount of work which it expended in losing its 2 feet per second, namely, 186,330 foot pounds, and this must be deducted from the work the wheel will do normally at full gate; so that the instantaneous value of power developed by the wheel while the water column is gain-

ing velocity would equal the normal power of the wheel at full gate minus the instantaneous value of power being expended upon the water column in getting up to speed.

It is evident that the speed of the water wheel would fall considera bly below normal and there would be absolutely no remedy for it in the present state of the art. I say this advisedly and have not forgotten the question of flywheels, which is undoubtedly in all of your minds at the present moment.

I wish to emphasize this line of reasoning, because it is, perhaps, the most important thing to be considered in setting water wheels where speed regulation is a desideratum. We can, in an imperfect way, provide for the expenditure of the energy necessary to slow up a water column, but there is no way to make a water column, while gaining velocity, do the work it is capable of when it has arrived at full velocity.

The important fact to which I want to especially call your attention is that the difficulty is measured not only by the length of the closed flume, but is inversely proportional to the size of the angle of hydraulic slope. When the sine becomes 1; that is, when the angle is 90°—or, in other words, when the closed flume is vertical—then the difficulties due to the fact that water moves slowly under the influence of gravity have reached their minimum, and the speed regulation will be the best obtainable. As the sine of the angle of hydraulic slope grows less, then the obtainable regulation grows worse.

There is one way in which the difficulties attendant upon a small angle of hydraulic slope may be in a measure compensated for, and that is by means of a standpipe. In an electric plant it is not usually of such importance that a load change amounting to the full capacity of the wheels be followed by a small speed variation, as that the comparatively large loads which go off and on for short intervals of time shall not disturb the speed to any great extent. Here is where the standpipe is of value. If a portion of the load goes off instantly, and the cor rectly designed governor promptly closes the gates to the correct position, the excess of water will flow out over the top of the standpipe and the water velocity in the flume will not be arrested so promptly as though there were no standpipe; neither will the pressure at the wheel be much increased. To obtain these results, the standpipe should be only a very little higher than the water level in the pond. It should be located as near the wheels as possible, and its top should be turned over so that the escaping water can be led to some convenient point of discharge.

If, after a load has gone off instantly, it comes on again in a short interval of time, it finds the water velocity in the flume but little diminished, and also the vertical water column in the standpipe is ready to apply its energy to the water wheel in the most advantageous manner. To make the last factor of much practical use, the cross section of the standpipe must be sufficiently large to prevent the level of the inclosed water column from falling much while the water in the closed flume is gaining its lost velocity. As a general statement, the larger the diameter of the standpipe and the less its height above the hydrostatic level, the better will be the speed regulation.

There has not, as yet, been sufficient practical experience with standpipes to formulate rules which will solve the least diameter which will result in any desired degree of speed regulation. In the writer's experience, it has been found that the use of a standpipe of ample proportions will render a plant governable within very close limits under ordinary operative conditions which had proved to be utterly ungovernable before the standpipe was installed.

It also gives perfect protection against dangerous water pressures being developed when circuit breakers open, or when, for accidental reasons, it is necessary to shut down the water wheels instantly.

It is usually the case that part of the head utilized in modern plants is below the water wheel in the shape of a draft tube; in fact, where horizontal wheels are used, it is practically necessary to have them a number of feet above tail water level for convenience of connection to the driven machinery. The same general rule holds good in regard to draft tubes, which, we have found, applies to closed flumes. They should be as short and as nearly vertical as possible. The maximum vertical length of a draft tube is, of course, limited by the atmospheric pressure. The water stands in the draft tube for the same reason that mercury stands in a barometer. Atmospheric pressure holds mercury up in the barometer tube—let us say 30 inches or 2½ feet—therefore it will hold water up in the draft tube $2.5 \times 13.6 = 34$ feet; that is, it would do so if the draft tube were airtight. The external atmospheric pressure at the top of such a draft tube would be 14.7 pounds per square inch. There are few draft tubes that would stand that pressure without leaking air. This fact is well recognized by hydraulic engineers, and it is rare to find draft tubes 25 feet high from tail water level to water wheel centers. If the water wheel is likely to be subjected to large load variations, it is very desirable that the draft tube should have a much less vertical height for the following reason:

At the bottom of a 25 foot vertical draft tube the atmospheric pressure is forcing the water up with a pressure of 14.7 lbs. per square inch, and the weight of the water is pressing down with a pressure of 10.75 pounds per square inch; that is, the difference between the air pressure and the weight is $14.7 - 10.75 = 3.95$ pounds. Now, if the water velocity in the draft tube is suddenly arrested by shutting the water wheel gates, the kinetic energy of the slowing water column will be found in the downward momentum of the water. This may easily create a downward pressure greater than 3.95 pounds per square inch, in which case a vacuum would be formed in the upper part of the draft tube and the column of water would sink in the draft tube and immediately after would rush upward again striking the bottom of the wheel with great violence. If we were so fortunate as to escape an accident of the kind above described we should find that with a draft tube of considerable height there is a tendency for air to leak in, and this, under the negative pressure of the weight of the water, expands into a partial vacuum so that the draft tube will be only partly filled with water, and as the position of the water wheel gates varies as the load changes, the water column in the draft tube will sway up and down, producing the effect of a pulsating head on the water wheel. This is very detrimental to good speed regulation, and is a very common annoyance encountered in practice.

Air chambers on flumes, to give protection against water hammer effects, are of very little practical use unless of ample size, even if they are full of air. The writer examined a plant so located that the bursting of the flume would have destroyed the whole plant and ruined an investment of at least $100,000. At the lower end of the flume was a large air chamber. The superintendent in charge pointed with pride to it, and confidently expressed the belief that it afforded ample protection against the dangerous strains on the flume due to water hammer. Upon examining the air chamber it was found to be entirely filled with water, and it had probably been in that condition for a considerable length of time. Water under pressure absorbs air with great facility. An air chamber should be provided with an air pump which may be readily connected to some convenient source of power, and with a gauge glass to show the water level. When so arranged, and if of ample size, it affords considerable safety against pressure developed when load goes off suddenly; but it is of no practical use as an aid to the governor in maintaining constant speed.

Aside from designing the water column along the lines already suggested, so that the water may gain its working velocity in the least possible time and also so that it may add to or take from the water wheel the least amount of the kinetic energy of the water, the next most important thing is the design of the water wheel gates and the method of connecting them to the governor.

As has already been pointed out, the gates are of necessity large and heavy, and yet they must be moved with great promptness and precision. The writer has had occasion to investigate with more or less accuracy the number of foot pounds necessary to open and close the gates of several hundred water wheels, and the surprisingly large variation in the amount of energy required, leads him inevitably to the conclusion that this matter has not received in many cases the careful engineering treatment which it deserves.

Water wheels are of many designs and sizes, and work under many different conditions of head, but there would seem to be no adequate reason why the gate of one water wheel developing a certain amount of power under a given head should require only 1,000 feet pounds to completely open it, and the gate of another water wheel of different make, developing the same amount of power under the same head, should require 60,000 feet pounds. Yet such has been found to be the case. The above example, taken from actual practice, is by no means unusual; and scores of such cases could be cited showing relatively absurd figures.

Some builders prefer to use cylinder gates on their wheels, others prefer wicket gates, while still others adhere to register gates. It is not the intention of this paper to enter into a critical comparison of the merits of these various types of gate, and, in fact, from the standpoint of speed regulation, no such comparison is necessary for the good and sufficient reason that there are wheels on the market of all three of the above kinds which show little to be desired in the ease with which the gates may be moved. It is also true that there are makes of wheels of all three kinds which cannot be governed accurately under variable loads, simply for the reason that their gates cannot be moved quickly enough.

It is often necessary to start a gate from a rest and completely open or close it in two or three seconds, or give it a proportionately smaller motion in a proportionately shorter space of time. Or what is still more severe, it is often necessary that while a gate is opening or closing its motion be instantly stopped and reversed.

If one will watch a thoroughly first class governor handling the gates of a water wheel which is driving an electric generator operating on a variable load, one is convinced of the fact that the governor has to develop considerable amounts of energy in surprisingly short spaces of time, and that the rigging connecting the governor and the gates is subjected necessarily to considerable strain, from which it follows that the easier the gates move the less chance there is of stripping gears and twisting off shafts; to say nothing of relieving the governor itself of unnecessary strain.

All gears between governor and gate—except immersed racks and pinions—should be cut, of first-class workmanship and not too large for the work required of them. The latter precaution is necessary to prevent the MV^2 energy in the gears themselves destroying the rigging when the direction of motion is suddenly reversed. Shafts should be of just sufficient size to give an ample factor of safety, and prevent torsional difficulties, for it is absolutely necessary that the smallest amount of motion of the governor shall be transmitted accurately to the water wheel gate. Lost motion in gears, and twisting of shafts are fatal to good regulation. Hand wheels should be so arranged that they may be entirely thrown out of connection with the rigging while the governor is in action, or they may be unkeyed in some simple manner.

Counterbalancing a gate is not the equivalent of having it in water balance. All vertical cylinder gates are necessarily out of balance to an amount equal to their immersed weight, but that is usually so small that it is not necessary to counteract it with a counterweight.

Some designs of gate show a violent tendency to close or stay closed. It is the custom to counterbalance such gates, and this practice leads to endless trouble on account of the kinetic energy in the counterweight. It being often necessary to reverse the motion of the counterweight suddenly, the kinetic energy expended at the amount of reversal is often sufficient to wreck the rigging. If counterweights must be used, it should be remembered that their kinetic energy is proportional to their weight, but also proportional to the square of their velocities; from which it follows that a heavy, slow-moving weight does less damage than a light, rapid-moving one.

It has been the custom of late to cast on to cylinder gates, fingers reaching out between the guides. These innocent looking devices, which are supposed to guide the water into the wheel properly, and hence raise its efficiency, are a source of no end of trouble when it comes to moving the gate quickly enough to produce good speed regulation. The direction of motion of the water as it enters the wheel is always such that it presses these fingers downward with tremendous force, giving the gate a strong tendency to close. By removing these fingers, the amount of energy necessary to open the gates can always be reduced by at least one-half, and oftentimes more than that. There are scores of water wheels on record which were so much out of balance, due to the fingers on the gates, that it was found impracticable to govern them satisfactorily on account of gears stripping and shafts twisting off. In the writer's experience, it has always been found practicable to govern these wheels by removing the fingers.

Now, as to the question of efficiency. The writer has often had to meet the argument of the few per cent. of efficiency supposed to be lost by removing these fingers, and to answer this question, tests have been made which show that there is no material gain in the efficiency of a water wheel set under ordinary working conditions, by attaching fingers to the gate.

Wicket gates also have their peculiarities. Some makers hang them in such a manner that they are practically in water balance in any position, and may be readily opened and closed with a small expenditure of energy. Such gates leave little to be desired, and wheels fitted with gates so designed may be governed with the greatest degree of exactness and without fear of injury to the rigging or governor. The writer has observed, however, that some wicket gates which move very easily have so much lost motion that in certain portions they tend to flop (no other word conveys the idea) first in one direction and then in the other, causing a pulsating speed which is very annoying and apparently inexplicable until one has investigated the cause. The danger of lost motion is greater with wicket than with cylinder gates, but with proper construction it is found in practice that lost motion may be entirely eliminated from wicket gates.

In some wicket gate wheels the wickets are hinged at one end and attached by the other end by tangential arms to a banjo, which in turn is geared to the shaft going to the governor. Such gates are entirely out of water balance when partly closed, and the more they are closed the more they are out of balance. Wheels with gates of this description are very difficult to govern. Frequently the strength of the wickets and radical arms is not sufficient to withstand the water pressure, even if sufficient energy can be supplied to them. In recent practice a wheel of this description was found to require some 40,000 foot pounds to open it. Another wicket gate wheel of different make but the same rated horse power was found to require only 5,000 foot pounds to open it. As another recent instance, it was found that a pair of wicket gate wheels of the kind described above required 19,000 foot pounds to open them; another pair of different make but the same rated horse power required but 2,500 foot pounds to open them. The wheels compared above were working under the same head.

Artificial Illumination for Ordinary Business and Domestic Purposes.

[A paper read by MR. LEON P. LOWE at the Seventh Annual Meeting of the Pacific Coast Gas Association.]

Aside from kerosene oil, the methods of artificial illumination prominently in use at the present time are ordinary commercial gas, electric light, acetylene gas and gasoline gas. The latter, used principally for isolated lighting, is much in disfavor chiefly because of the dangerous nature of gasoline, and, as it is rapidly giving way to acetylene gas, it will not be further considered here. As the electric arc light, preeminently the light for exterior use and the illumination of large areas, is not used for domestic purposes, and, comparatively speaking, but little for business purposes, therefore, this article will be limited to the consideration of ordinary gas, incandescent electric light and acetylene.

For many years the gas in use throughout the United States was what is known as coal gas, the candle power of which, in its plain state, was usually about 16, and for that reason the ordinary incandescent electric light of the present day is of 16 candle power, that standard having been adopted for electric lighting to meet the competition of the gas in general use when electricity was first introduced. Later discoveries and developments in the gas industry brought water gas into prominence, and to such an extent that at this time from 70 to 75 per cent. of the illuminating gas of the United States is made by the water gas method, one of the principal advantages of which is its superior quality, it being usually of about 20-candle power, though in some localities gas of higher grade is made. Many companies still use the coal gas method, though in such cases enrichment is usually resorted to in one way or another, the gas being thereby increased in quality, until it is now safe to say that illuminating gas, as usually sold, is of about 20-candle power, which practically means that a good, plain, ordinary burner, when consuming gas at the rate of 5 cubic feet per hour, will give a light equal to 20 standard sperm candles.

Gas illumination has been greatly increased in effectiveness and reduced in cost by the introduction of the incandescent gas light, in which the gas is used to heat to incandescence a mantle made of special heat resisting material. Such lamps are of various kinds and sizes, though the best and most popular are of the familiar Welsbach type, and of a size which consumes about 2½ cubic feet per hour, and, when so adjusted, will give a light of about 60-candle power, or three times as much as the plain gas jet, though using but one-half the amount of gas; thus, light for light in volume, costing but 1 6th as much to operate.

Gas selling rates are based on the consumption of 1,000 cubic feet, and electricity on 1,000 watts; the "cubic foot" being the standard of gas, and the "watt" of electrical measurement.

The cost of incandescent electric lighting depends upon the efficiency of the lamp in use, which means its comparative light-giving power for the amount of current consumed. The "efficiency" of an electric lamp varies considerably, but experience has demonstrated that a lamp of good light-giving power, together with a reasonably long life, requires the consumption of 3.6 watts per candle power per hour, such lamps being the kind in ordinary use.

A 16-candle lamp would, therefore, use 57.6 watts of electricity per hour, while lamps of lesser or greater power are supposed to use electric current in proportion to the amount of light given.

Acetylene gas is derived from what is known as calcium carbide, a product manufactured from pulverized lime and carbon (usually coke),

combined in an electrical furnace, the intense heat of the electric arc being necessary to reduce and fuse the two together. It will thus be seen the cost of carbide manufacture depends upon the cost of the materials and the generating of the necessary electric current, the latter being most cheaply done by water power, and, therefore it is that the principal carbide manufacturing plant of the country is located at Niagara Falls, N.Y., at which place the cheapest electric current is had, as well as a convenient supply of the necessary materials.

Acetylene gas is produced by the action of water upon this calcium carbide, in machines especially designed for the purpose, and, to use the words of the President of the Illinois Acetylene Company, "One pound of good commercial carbide contains 5 cubic feet of acetylene gas." This gas, judged by the standard of gas illumination described above, is of about 240 candle power per 5 cubic feet. It is not practical to use it in the ordinary gas burner, a special form being required through which it is burned at the rate of about ½ cubic foot per hour, giving a theoretical candle power of 24. The best and most practical forms of acetylene burners introduce a small amount of air into the gas at the point of combustion, thus somewhat lowering its light giving power, so that for each ½ cubic foot consumed a light of about 20-candle power is developed. Acetylene gas gives a very soft, brilliant light; its use is, however, attended with some danger and the inconvenience made necessary by the attention to the gas machine.

For this locality (California) the carbide is shipped to San Francisco in carload lots of 100 pound packages, and from there distributed in any quantity to points of consumption, the price f.o.b. cars, being 6 cents per pound for any amount less than a car load, this being the lowest price obtainable, and to which the consumer must add the additional cost of transportation to point of consumption. This will vary in accordance with distance from point of shipment, but may be safely estimated at 1 cent per pound, counting transportation and cartage on material and package, together with hauling and deterioration of carbide by exposure to the air, making its cost 7 cents per pound to the consumer.

Without cost of transportation, as would be the case in San Francisco and when no allowance is made for hauling, the cost would be 6 cents per pound.

The selling prices of gas and electricity differ very widely, depending upon size of city, local conditions, etc., though gas should not exceed $2.50 per 1,000 cubic feet, and from that to as low as $1, the latter price, however, being at present an unknown one on the Pacific Coast.

Electricity will vary in cost from 10 cents to 20 cents per 1,000 watts, the majority of consumers probably paying from 15 to 20 cents.

From the above data it is possible to make a relative comparison of the cost of these methods of illumination, though to do so they must first be reduced to a common basis, known technically as the candle hour.

A "candle hour" is a light of 1 candle power during 1 hour of time; thus, a 20-candle power light is also of 20 candle hours, giving 20 candle power for 1 hour, or, theoretically, 1-candle power for 20 hours. The necessity for such a comparison is obvious when it is considered that some one particular light may cost more per hour for its operation than another, and yet be really cheaper because of its extra light giving power. For instance, a comparison of an electric arc light with an ordinary gas jet or incandescent electric lamp would not be thought of, for, while the arc light costs much more for its operation, it is capable, because of its greater illuminating power, of displacing so many of the smaller lights as to make its use cheaper when a large amount of light is desired. So it is with the Welsbach gas light, which, giving 60 candle power, is the equal in illumination of three 20-candle power plain gas jets, and of almost four 16 candle power electric lights.

The tendency of the times is to greater illumination, especially in business places, a brilliantly lighted store being considered the best kind of an advertisement. The demand for increased illumination without greater cost to the consumer is the secret of the popularity of the Welsbach light, and for this reason it has not always displaced other lights in proportion to its illuminating power. Where once used, however, and proper attention is given to its care, the adoption of either of the other lights in its stead would demand an increase in their number in direct proportion to the amount of illumination desired.

For a clear and comprehensive comparison of these different lights, the above data is arranged in five tables as follows:

Table No. 1 shows cost per hour of the various lights at different selling rates.

Table No. 2, same as No. 1, the arrangement of lights being in accordance with their cost.

Table No. 3 shows candle hours of the various lights given for $1 at different selling rates.

Table No. 4, same as No. 3, the arrangement being in accordance with the amount of light given.

Table No. 5 is graphic illustration of table No. 4.

There has also been arranged a table showing the price per 1,000 watts at which current for the electric incandescent light would have to be sold to equal in illumination and economy the Welsbach gas light, at prices ranging from $2.50 to $1 per 1,000 cubic feet.

In these comparisons the proper kind and working conditions of the various lights are assumed. The electric current and gas are of the kinds in ordinary commercial use, the gas used in the Welsbach lights being the same as that used in the ordinary or plain burner.

For those desiring general information concerning gasoline gas and the electric arc light, in comparison with the above, it may be stated that gasoline gas is ordinarily considered as being, in cost, about the equal of commercial gas at from $1 to $1.50 per 1,000 cubic feet, depending upon the cost of gasoline.

The electric arc light, at prices usually charged, is about the same in cost as Welsbach lights with gas at $1 per 1,000, when giving the same amount of light, the latter, however, having the advantage of much greater economy when their use is limited to a short time. All gas lights also possess the advantage of greater economy because of its being possible to lower them when only a small amount of light is required.

In these comparisons it has not been thought necessary to consider the question of cost of lamp renewals such as are necessary with both the electric light and incandescent gas light, as their life and cost are practically the same. As at present in use, both are satisfactory and add but little to the cost of illumination. They are being rapidly developed and improved, the progress of the incandescent gas mantle being especially noticeable and much in advance of its electrical competitor.

The foregoing is thought to be a plain, fair statement of the present state of the art of lighting by usual artificial methods. In its preparation all technical terms have been eliminated as far as possible, and, where their use has been imperative, it has been the aim of the author to make their meaning clear.

TABLE NO. 1.—*Showing Cost per Hour of Different Lights.*

Kind of Light.	Candle Power.	Selling Rate.	Cost per Hour.
Gas, ordinary burner.	20	$2.50 per 1,000 cu. ft.	1.25 cents.
" " "	20	2.00 " "	1 cent.
" " "	20	1.75 " "	.875 "
" " "	20	1.50 " "	.75 "
" " "	20	1.25 " "	.625 "
" " "	20	1.00 " "	.5 "
Gas, Welsbach light.	60	2.50 " "	.625 "
" " "	60	2.00 " "	.5 "
" " "	60	1.75 " "	.4375 "
" " "	60	1.50 " "	.375 "
" " "	60	1.25 " "	.3125 "
" " "	60	1.00 " "	25 "
Electric incandescent.	16	.20 per 1,000 watts	1.152 "
" "	16	.15 " "	.864 "
" "	16	.10 " "	.576 "
Acetylene gas.....	20	.07 lb. calcium carbide.	.7 "
" "	20	.06 lb. " "	.6 "

TABLE NO. 2.—*Showing Cost per Hour of Different Lights, Arranged in Accordance with Cost.*

Kind of Light.	Candle Power.	Selling Rate.	Cost per Hour.
Gas, ordinary burner.	20	$2.50 per 1,000 cu. ft.	1.25 cents.
Electric incandescent.	16	.20 per 1,000 watts	1.152 "
Gas, ordinary burner.	20	2.00 per 1,000 cu. ft.	1 "
" " "	20	1.75 " " "	.875 "
Electric incandescent.	16	.15 per 1,000 watts	.864 "
Gas, ordinary burner.	20	1.50 per 1,000 cu. ft.	.75 "
Acetylene gas.....	20	.07 lb. calcium carbide.	.7 "
Gas, ordinary burner.	20	1.25 per 1,000 cu. ft.	.625 "
Gas, Welsbach light.	60	2.50 per 1,000 cu. ft.	.625 "
Acetylene gas.....	20	.06 lb. calcium carbide.	.6 "
Electric incandescent.	16	.10 per 1,000 watts	.576 "
Gas, ordinary burner.	20	1.00 per 1,000 cu. ft.	.5 "

(TABLE NO. 2.—*Continued.*)

Gas, Welsbach light.	60	$2.00 per 1,000 cu. ft....	.5	cent.
" " "	60	1.75 " "	.4375	"
" " "	60	1.50 " "	.375	"
" " "	60	1.25 " "	.3125	"
" " "	60	1.00 " "	.25	"

TABLE NO. 3.—*Showing Candle Hours Given for $1 by Different Lights.*

Kind of Light.	Candle Power.	Selling Rate.	Candle Hours for $1.
Gas, ordinary burner.....	20	$2.50 per 1,000 cu. ft.....	1,600
" " "	20	2.00 " "	2,000
" " "	20	1.75 " "	2,286
" " "	20	1.50 " "	2,667
" " "	20	1.25 " "	3,200
" " "	20	1.00 " "	4,000
Gas, Welsbach light.....	60	2.50 " "	9,600
" " "	60	2.00 " "	12,000
" " "	60	1.75 " "	13,714
" " "	60	1.50 " "	16,000
" " "	60	1.25 " "	19,200
" " "	60	1.00 " "	24,000
Electric incandescent.....	16	.20 per 1,000 watts.....	1,389
" "	16	.15 " "	1,852
" "	16	.10 " "	2,778
Acetylene gas.....	20	.07 lb. calcium carbide.	2,857
" "	20	.06 lb. " " ..	3,333

TABLE NO. 4.—*Showing Candle Hours Given for $1 by Different Lights Arranged in Accordance with Light Given.*

Kind of Light.	Candle Power.	Selling Rate.	Candle Hours for $1.
Electric incandescent.....	16	$0.20 per 1,000 watts.....	1,389
Gas, ordinary burner.....	20	2.50 per 1,000 cubic feet..	1,600
Electric incandescent.....	16	.15 per 1,000 watts.....	1,852
Gas, ordinary burner.....	20	2.00 per 1,000 cubic feet..	2,000
" " "	20	1.75 " " ..	2,286
" " "	20	1.50 " " ..	2,667
Electric incandescent.....	16	.10 per 1,000 watts.....	2,778
Acetylene gas.....	20	.07 lb. calcium carbide..	2,857
Gas, ordinary burner.....	20	1.25 per 1,000 cubic feet..	3,200
Acetylene gas.....	20	.06 lb. calcium carbide..	3,333
Gas, ordinary burner.....	20	1.00 per 1,000 cubic feet..	4,000
Gas, Welsbach light.....	60	2.50 " " ..	9,600
" " "	60	2.00 " " ..	12,000
" " "	60	1.75 " " ..	13,714
" " "	60	1.50 " " ..	16,000
" " "	60	1.25 " " ..	19,200
" " "	60	1.00 " " ..	24,000

TABLE NO. 5.—*Comparative Graphic Diagram Showing Candle Hours Given for $1 by Different Lights.*

Electric incandescent, at 20 cents per 1,000 watts.

Gas, ordinary burner, at $2.50 per 1,000 cubic feet.

Electric incandescent, at 15 cents per 1,000 watts.

Gas, ordinary burner, at $2 per 1,000 cubic feet.

Gas, ordinary burner, at $1.75 per 1,000 cubic feet.

Gas, ordinary burner, at $1.50 per 1,000 cubic feet.

Electric incandescent, at 10 cents per 1,000 watts.

Acetylene gas, at 7 cents per pound for calcium carbide.

Gas, ordinary burner, at $1.25 per 1,000 cubic feet.

Acetylene gas, at 6 cents per pound for calcium carbide.

Gas, ordinary burner, at $1 per 1,000 cubic feet.

Gas, Welsbach light, at $2.50 per 1,000 cubic feet.

Gas, Welsbach light, at $2 per 1,000 cubic feet.

Gas, Welsbach light, at $1.75 per 1,000 cubic feet.

Gas, Welsbach light, at $1.50 per 1,000 cubic feet.

Gas, Welsbach light, at $1.25 per 1,000 cubic feet.

Gas, Welsbach light, at $1 per 1,000 cubic feet.

Table showing Prices at which Electricity must be sold per 1,000 Watts to equal, in Illumination and Economy, the Welsbach Gas Light.

When Price of Gas Is	Price of Electricity Must Be
$2.50 per 1,000 cubic feet.	2.89 cents per 1,000 watts.
2.00 " "	2.32 " " "
1.75 " "	2.03 " " "
1.50 " "	1.74 " " "
1.25 " "	1.45 " " "
1.00 " "	1.16 " " "

Arc Machine Regulation.

By MR. H. FRANKLIN WATTS, in *Elec. Engr.*

The Thomson-Houston system of arc lighting having established itself in nearly every quarter of the globe, is now so well known and understood that any remarks pertaining to its operation may at this late date appear rather untimely.

While the writer verily believes that it is not yet too late to learn the old dog a new trick or two, he has no intention of doing so at the present moment, but will direct his remarks mainly to the systems of regulation employed in some of the arc systems now in extensive use and to criticize some of the regulators, and above all to suggest a remedy for their shortcomings. He may as well say at once that there is, in the writer's opinion, no system of arc machine regulation in the world that can touch the Thomson-Houston in point of reliability, simplicity or character of the results obtained. Nor is it at all likely that the next twenty years will witness any material improvement in this direction. Of course, to do away with the necessity for a regulator of any kind by "inherent regulation" or otherwise, would constitute a great improvement, but while we hear much about "inherent regulation," it does not appear to warrant the importance that has been attached to it. "Forced regulation" must still be employed to compel the machine to do what it would not otherwise do. This applies more particularly to the machine first mentioned, but also in a large degree to certain other dynamos that lay great claims to this feature; but whether inherent or forced, the T-H regulator does its work so well that one is apt to forget that the controller on the wall has any part or interest in what the machine is doing. It virtually takes the place of a faithful attendant, and sleepless and tireless, is ever adjusting and readjusting the current to standard strength.

The regulator is the heart of any system, and it matters not how good the design of the dynamos may be, it cannot give good results unless the current is held very closely to its correct amount, and the closer the regulation the better is the service. The regulator is to the arc dynamos what the governor is to the steam engine. No engineer would think of running his engine with its governor disconnected under the excuse that the load is "constant" and that the governor was not needed; yet it is very common to find arc dynamos—of the very latest type too—whose regulators (?) are out of service, the real reason being that it has been found to be a very ticklish and difficult thing to adjust them, there being several different points to adjust. Furthermore, when all adjustments have been made, they are not permanent, and perhaps the next night the whole operation must be repeated. No wonder the dynamo man gets disgusted and disconnects it altogether and regulates by hand.

Did any one ever hear of a T-H regulator being disconnected? The writer has known these regulators (the T-H) to do their work for years with absolutely no attention. He has also observed that after being transported hundreds of miles by freight, on starting up it is found the original adjustment made in the factory is still correct to 1-10 ampere. Is there any other arc machine regulator in the world of which this can be said?

There are many plants in this country operating a large number of T-H arc dynamos with the number of attendants reduced to an extent that would be impossible with any other system. A certain station has four large compound condensing engines and 28 arc dynamos, besides several incandescent machines and a few alternators. But two men are on duty at night in the machine room, one of whom looks after all the dynamos, with the occasional help of one of the firemen if anything goes wrong.

Some regulators have a formidable array of spur gearing, friction wheels, pawls and ratchets, brought into action by a magnet in the main circuit. The friction wheels become worn, the ratchet is soon smooth, lost motion takes place, the play of the magnet armature is increased; it loses its sensitiveness, two or three amperes variation

being necessary to start it, and when it does start it is apt to go too far and over-correct the current. A magnet having much range of movement and considerable mechanical labor to perform cannot possibly be sensitive to small variations of current, especially when pulling against a strong spring and stiff dash pot, unless it is under control of a relay. This brings us back to the T-H regulator, whose controller has nothing to do but to jump up and down, in response to current changes, and herein again lies its superiority.

The T-H regulator is essentially the station man's friend; indeed, no friend or brother was ever truer to his principles than is this simple device which, through the long hours of the night, amid the swish of belting and the clatter of air blasts, unnoticed, uncredited, performs its exacting and monotonous duty with a zeal and fidelity that knows no mistake.

As is well known, these machines are no longer manufactured, and with them has gone the heart and soul, and, to many minds, the secret of the success of the T-H arc system. For the demise of the dynamo with its inaccessible armature few tears will be shed, but for the regulator there is no lack of mourners who bewail its untimely end.

Instead there has been developed a line of two and four-pole machines which, regarded as generators of electricity, are far superior to the ones thus discarded, having features of great value, such as very heavy insulation, greater accessibility of the armature and withal in much larger sizes and doing away in large plants with the proverbial "acres of dynamos;" but, I regret to say, many having regulators which are not possessed of one redeeming feature or a single excuse for life.

The central station manager of experience who regards the breaking down of his machinery as a great calamity, often spending thousands of dollars in duplicating engines and dynamos, regards these machines with a critical eye. He admires their solid, substantial construction, the large shaft with self oiling bearings. He approves of the tremendous insulation on the armature and its positively driven coils as well as the absence of band wires. He notes with pleasure the large and broad driving pulley, also the moderate speed of the armature and the generous proportions of the commutator, on which a great deal of care has been bestowed. But when he looks at the regulator it gives him a pain and he very naturally inquires: "Why don't they put the T-H regulator on this machine, thus reflecting credit upon the factory and station alike?" Don't tell him this cannot be done. Such a thought is silly. He knows better. The T-H regulator magnet is very powerful and can easily be made more so if necessary. He has no use for sewing machine belts, worm gears or magnetic clutches. He sees no necessity for oil pumps, balanced valves or rotary pistons.

Years of experience has taught him that there is no more necessity for a rheostat on an arc machine than for an extra tail on a cow. Why is he so sure of all this? Because he has seen it done for years, not on this machine, it is true, but on one of much poorer electrical design and far more difficult to regulate, and which, moreover, lays no claims to "inherent regulation by armature reaction," and accomplished, too, with none of the contraptions above mentioned. It matters not how different the characteristics of the machines may be, this regulator will regulate it and do it well if it is given a chance.

The designers of one of these dynamos, for whom the writer has the highest regard, states that by the use of the rheostat he saves 650 watts at one-quarter load out of a total of 62,000—equal to about 1 per cent.; and that by winding more wire on the armature the machine would deliver its standard current at all loads without the rheostat. Yet to save this 1 per cent., which is done at one-quarter load only, he finds it necessary to encumber his machine with a useless and complicated device which has no business on an arc machine, in which freedom from breakdowns should be the first consideration. First reduce the probabilities, then the possibilities of accident.

Will the stockholders, manager, engineer, financier or machine man ever know whether the 650 watts is saved or wasted? Is not economy secondary to reliability? Nothing short of an indicator or wattmeter will ever know the difference, especially as a machine and engine of this size are not likely to be run at one-quarter load for any great length of time.

Prof. Thomson might also have applied a rheostat to his machine and with even greater advantage, since his dynamos (the 50-light) cannot be operated safely at small loads unless the field is shunted; but he apparently decided that it would add too much complication, his aim being to produce a machine of the greatest possible simplicity, and which could be operated without expert attention.

Better wind more wire on the armature, throw the regulator and rheostat overboard, and substitute the Thomson-Houston regulator. There will then be combined in this machine the cream of two systems, all of their good points and none of their bad ones—a machine far superior to many of the later types supposed to be the highest expression of the designer's skill.

Mr. Bryan Donkin on Smoke Prevention.[1]

Mr. Bryan Donkin recently presented in the columns of the *Engineer* a concise statement of the actual state of smoke prevention practice, which should be a useful guide to factory owners and others in view of the renewed activity of local authorities in respect of the suppression of the smoke nuisance. Mr. Donkin's essay is of considerable length, and we cannot find space for the whole of it; but an abstract, giving the writer's principal points, will be interesting to gas engineers, whose professional labors indirectly tend powerfully to the suppression of both industrial and domestic smoke.

Nothwithstanding the growing use of gaseous fuel—a branch of the subject which is rather beyond Mr. Donkin's scheme of treatment—he holds that the discharge of smoke into the atmosphere is increasing. This is due to the increase of population, to the tendency of this population to crowd into the large towns, and to the fact of coal having become the universal fuel. A good deal of the coal burnt at home and abroad is very smoky. We are disposed to think that, as a practical question, the comparative smokiness of the coal used is one of the most important factors in this modern problem of smoke prevention. Half a dozen chimneys where the smokiest varieties of coal are used, for the sake of cheapness, will make more dirt in the air than scores of others where the fuel is cleaner. The dirtier coals being also usually the cheaper, this factor is unfortunately likely to increase in importance rather than to lessen with time. As Mr. Donkin remarks, "to put pressure on the owners of chimneys to burn their own black smoke, or rather not to allow them to produce it, is the difficult question which is now actively occupying the public mind." It is becoming a question also whether the pressure should not be applied at an earlier stage—that is, with regard to the character of the fuel burnt.

Upon the old query of which are the greatest offenders, factory chimneys or domestic fires, Mr. Donkin decides against the domestic hearth, on the ground that "domestic chimneys make up in quantity for the smaller amount of smoke emitted from each of them separately." He estimates that there are about 1,000,000 inhabited houses in the area called London. Reckoning only two chimneys smoking from two fires (kitchen and another) in winter, we find 2,000,000 chimneys smoking more or less from 7 A.M. to 11 P.M. during the six winter months, and about 500,000 in summer. The maximum of domestic smoke is given off at and about the time of lighting—say, between 7 and 9 o'clock in the morning. On a reasonable computation, the equivalent single chimney stack for all these small flues would be a shaft 1,000 feet square. This suggestion recalls the old fancy of would-be sanitary reformers for collecting all household chimneys into great district stacks, from which the smoke could be discharged in a mass. It is difficult to see the advantage of this alteration. If the smoke is once made, it cannot be got rid of by any condensing or washing process known; and the larger the bulk of it that is discharged into the air at one place, the greater the nuisance. This is one very good reason why, for all its shortcomings, the domestic chimney is not, and cannot be, such a nuisance as the factory, locomotive or steamboat chimney. The ultimate destination of all smoke is to be diffused in the atmosphere. This being so, diffusion at a multiplicity of small points is preferable to, and really more scientific than, ejection in a great mass at one time. So, to the most heedless observer, one factory, locomotive or steamboat chimney pouring out black smoke with hearty good will, as many of them do, fills the circumambient air with reek that hundreds of household fires could not produce.

We are glad that Mr. Donkin takes due notice of a class of chimneys which possess, and exercise, peculiar powers of offending in this respect. These are the chimneys of bakeries, restaurants and hotels, which commonly occur in the greatest plenty, and exhibit most activ-it, in the best residential and fashionable quarters of English towns. The City of London is full of refreshment houses, their being in 1897 no fewer than 614 establishments in the square mile of the city area where food was cooked for sale. "At a few of these places gas stoves are used, giving no smoke; but the larger number are great offenders in this respect." The Medical Officer of Health has reported in favor of compelling this class of tradesmen to use gas fuel only; but Mr. Donkin opines that "it is difficult to draw distinctions," by which expression he seeks to imply that the small cookshops would be trouble-

1. *Journal of Gas Lighting*, England.

some to catch, although their kitchen chimneys might be among the smokiest for the time during which cooking is going on. We do not see, however, why the Smoke Prevention Acts should not be amended, if necessary, in order to give local authorities more power over those shopkeepers who use fires for business purposes. The advantages of cooking by gas are so patent, moreover, that there could be no real hardship in putting pressure upon the backward cooks who still prefer smoky fires, to the general inconvenience, in order to induce them to adopt the cleanlier fuel. There will always be old-fashioned people who will cling to the means and appliances of their youth in despite of all improvements in culinary apparatus. It is possible to greatly sympathize with their steadfastness, while deploring, and endeavoring to cure, its incidental inconvenience.

This consideration, however, opens up the question already mooted —of whether the prevention of smoke might not be undertaken more hopefully, in certain cases, by dealing with the character of the fuel itself. To insure, for example, that a restaurant keeper should burn nothing but gas for cooking would be a far more drastic remedy than merely fining him whenever his kitchen chimney transgressed the law, and was caught. Similarly, if a factory owner were under engagement to burn nothing but coke or anthracite for steam raising, his chimney need not be watched. This being a free country, a great outcry would arise upon any proposal to make factory owners take out licenses for industrial furnaces or chimneys to which smoke preventing conditions could be attached; but possibly a gentle, continuing pressure within the limits of the existing law might be found effective. Mr. Donkin admits that "the use of anthracite or smokeless coal is difficult to enforce, as it is expensive and troublesome to him. Gas coke is often used in domestic grates and boiler fires, and gives no smoke." Why, then, is the latter description of fuel ever a drug in the market?

The compulsory use of coke for factory furnaces being beyond hoping for, Mr. Donkin grapples resolutely with the problem of smoke prevention in connection with the use of bituminous coal for steam raising. Incidentally, he mentions the case of locomotives, which are perhaps greater offenders in this respect than factories, now that they generally burn bituminous coal. They used to burn coke. Why the alteration —motive of economy, or what? If the former, it is certainly an outrage that for the sake of a saving on the fuel bill a railway company should be permitted to create a nuisance at discretion. The point of economy, of course, comes early into the question. Mr. Donkin admits that "the amount of carbon escaping combustion is much too small to make the suppression of smoke on the score of economy of any practical value. It is for sanitary reasons that it should be as far as possible diminished." If all popular smoke abatement agitators had recognized this truth, their zeal in the cause might have been more fruitful of good results.

In order that prosecutions against the owners of smoky chimneys may be sustained on something like systematized proof, various means of measuring the density or the blackness of the smoke have been suggested, and tried. Mr. Donkin reviews the most hopeful of these tests; and, while acknowledging that something of the kind is essential, he finds nothing satisfactory except the smoke scale proposed by M. Ringelmann, described in his own book on the "Heat Efficiency of Steam Boilers." In this method the density of the smoke is compared, by a sort of photometric observation, with the apparent greyness produced by black lines of graduated thickness, crossed on white paper. Ringelmann recognizes five shades of smoke, as in Switzerland and Germany —namely, (1) White transparent vapor; (2) light brown smoke; (3) brownish grey smoke; (4) dense smoke; (5) thick black smoke. The divisions are drawn empirically; and Ringelmann's scale is intended to facilitate the classification of any smoke by direct comparison. "These diagrams should be hung up in such a way, and at such a distance from the observer, that he can see both them and the top of the chimney under inspection at the same moment, and in the same line of sight." Mr. Donkin declares that the advantages of such a standard method of comparison are great; but it has its drawbacks also. After all, the word of the observer has to be taken; and when a reliable man has learnt the ordinary meaning of the classifications of smoke density, he can judge them by a glance, from any standpoint. There is no real need for a scale to identify black smoke when one sees it. The chief difficulty to prove is the duration of emission.

Assuming that there is no denying the fact of a chimney smoking, the next question is how to stop it. Supposing, further, that the coal is of a smoky nature, the difficulty of burning it smokelessly is great and obvious. Mr. Donkin thinks the best results are to be attained by proper regulation and division of the air supply, and by careful stoking. Heating the air before admitting it to the fire is too complicated a device. Down draught furnaces, rather in favor in America, are open to the same objection. Powdered coal is promising; but has hardly progressed beyond the experimental stage. The Germans, whose native coal is very dirty indeed, have not made much of a hand at burning it smokelessly, for all their vaunted science. Frenchmen are in the same case. There have been German and French Smoke Abatement Commissions, which have arrived at practically the same opinions on the subject as those generally received in this country. These are, that apart from the superior solution of burning nothing but smokeless fuel, any ordinary fire grate, if carefully stoked with fairly good coal, can be made to emit much less smoke than it generally does. It is not to the manufacturers' interest to trouble himself about the matter as regards economy of fuel, and consequently such constraint as it is expedient to put upon him must be instigated by regard for the public interest. This is the whole thing in a nutshell. Since so many local authorities in England have had factories of their own to manage, they have not been so very hard upon manufacturers for doing what they have only too often done themselves—bought cheap steam coal and "chanced" the effect of the chimney.

In summing up the whole question, Mr. Donkin wisely remarks on the numerous considerations that affect the desired solution of the difficulty. A marked evil is that boilers are often too small for the work of evaporation required of them, which means forced firing; and this with the generality of fuel means a smoky chimney. Stokers are not always adequately paid, or encouraged to do the best work. Moreover—and this is a highly important point—the top of the chimney is rarely visible from the stokehole; so that the fireman with the best intentions cannot see what he is doing. Boiler owners are oftener to blame than the stokers for the quantity of smoke made; for they buy the coal and the tools. Finally, many owners and stokers know little or nothing of the laws governing combustion. Whether they would be willing to receive instruction on the subject from County Council Instructors is another question. We rather incline to the opinion that expert assistance in enforcing the provisions of the existing law would be productive of more good. There is too much uncertainty about the actual procedure; and while this is the case, and the provision of smoke preventing appliances means outlay on which the factory owners cannot see any positive returns, the latter will continue to run the risk of prosecution rather than take any steps.

Unfortunately, the first means of protection that occurs to the average factory owner is to bribe somebody to let him alone. It is only when this expedient fails that the manufacturer seriously thinks of putting his furnaces in order. Meanwhile, is it anybody's business to advise factory owners to try coke? We have heard of manufacturers with places within a gunshot of a London gas works, who had never thought of coke as a boiler fuel. The average stoker does not know anything about coke, or if he does, it is not to the advantage of this fuel, simply because it necessitates a little more regular attention than a costly coal. A few smart fines, increasing every time, are the only means of awakening people of this sort out of their lethargy. We are of opinion that if London factories only tried what could be done with coke—with intention to succeed—there would be less of this commodity to export. Neither is the domestic consumption of coke in London anything like what it might be if there were less officialism and more business push behind the local trade.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

At a special meeting of the proprietors of the Capital Gas Company, of Sacramento, Cal., Mr. Albert Gallatin was elected President, vice Mr. Joseph Terry, resigned. Mr. J. Addison was elected Vice-President, and Mr. W. L. Rennie was chosen Secretary and Treasurer, vice Mr. C. H. Cummings, resigned. The last named gentleman retires from the Company's service with the hearty esteem and best wishes of those who were obliged to supersede him.

Mr. George Landis Wilson, President of the International Acetylene Association, has notified us that a special meeting of the Association will be held in the Great Northern Hotel, Chicago, the 14th and 15th inst. He further says that "prominent men in the trade have promised to be present, and we have assurances from the management of the Union Carbide Company that the Company will be well represented at banquet."

Mr. H. E. Chubbuck, General Manager of the Quincy (Ills.) Light and Power Company, has contracted with the United Gas Improve-

ment Company for a set of its standard, Lowe water gas apparatus, up to a daily capacity of 250,000 cubic feet. The Light and Power Company is successor to the properties of the Quincy Gas Light and Coke Company and the Empire Light and Power Company.

MR. I. KATZENBERGER, President of the Equitable Gas Light Company, of Memphis, Tenn., writing to us under date of July 31st, says: "In your issue of July 24th, page 122, I note you state that the Logan Company, of Brooklyn, N.Y., has a contract with the Gas Company of Memphis, Tenn., for a steel tank. Will you kindly correct this and state that the contract for the iron work at Memphis, Tenn., has been given to Messrs. Bartlett, Hayward & Co., of Baltimore. This is in justice to the last named concern."

AT the annual meeting of the Fitchburg (Mass.) Gas and Electric Company the officers chosen were: Directors, Rodney Wallace, Henry T. Page, Charles T. Crocket, Chas. E. Ware, George E. Clifford, Herbert I. Wallace and Francis B. Shipley; President, Rodney Wallace; Clerk, Treasurer and General Manager, H. F. Coggshall. In connection with these elections it is noteworthy that Mr. Wallace is serving his 36th consecutive term as the Company's President, and Manager Coggshall is serving it as such for the 46th time. Truly these must be faithful servants.

AT a special meeting of the Directors of the Springfield (Mass.) Gas Light Company, the following minutes to the memory of the late Mr. Marvin Chapin were adopted:

"Marvin Chapin, the senior member of our Board of Directors, departed this life on the 27th day of June last, at the age of nearly 93 years. In his death the Springfield Gas Light Company loses the services of a most faithful and efficient officer. For 43 years he was a member of its Board of Directors, and for 13 years of such time he was its President. His interest in the welfare of the Company was very marked, and he gave to its affairs close attention and careful study, always showing good judgment and contributing wise counsel.

"His presence at the meetings of the Board, as well as his visits at the office of the Company, will be greatly missed. Mr. Chapin had the entire respect and confidence of the people of Springfield, where he had resided for more than half a century, and he took pleasure and pride in watching and assisting in the remarkable growth and prosperity of this city. He was a kind neighbor, a good friend, a loyal citizens and a true Christian.

"*Voted;* That this testimonial be placed upon the records of the Company, and that a copy of the same be sent to the family of the deceased."

THE following is from a recent number of the Chelsea (Mass.) *Pioneer:* "At the annual meeting of the Chelsea Gas Light Company the following officers were re elected: Clerk, Albert D. Bosson; Treasurer, George W. Moses; Directors, George W. Moses, Jabez K. Montgomery, Francis Low, Thomas Martin and Albert D. Bosson. A *Pioneer* reporter interviewed Mr. Bosson and asked him if his Company had taken any action towards introducing Whitney coke oven gas in Chelsea. He replied: 'Whenever the Whitney works are prepared to produce gas for distribution, we expect that we shall have an opportunity to confer with Mr. Whitney. Such is the arrangement made with Mr. Tudor, the Treasurer and confidential man for Mr. Whitney. Up to the present date we are advised that the works at Everett are not producing any gas for distribution.'"

MR. I. KATZENBERGER, General Manager of the Kern Incandescent Gas Light Company, of this city, informs us that the Company will not be able to supply any burners on a commercial scale until October 1st.

MR. J. CHAS. ROSS, Superintendent of the Port Chester (N. Y.) branch or station of the New York Suburban Gas Company, forwards the following advertisement respecting a change in the selling rates, which has appeared prominently in the Port Chester newspapers: "The New York Suburban Gas Company takes pleasure in announcing that, commencing August 1st, the price of gas will be reduced 25 cents per 1,000 cubic feet. The new rate is as follows: For lighting purposes, $1.70 per 1,000 cubic feet, with a discount of 20 cents per 1,000 for prompt payment, which brings the net price to $1.50 per 1,000, provided bills are paid within 10 days after presentation.

"Under the terms above given, together with our price for fuel purposes at $1.25 per 1,000 cubic feet, Port Chester is procuring gas at a lower rate than any other place of equal size in this State, and the Company hopes by this reduction to induce the more general use of gas by the citizens."

AT the annual meeting of the Beverly (Mass.) Gas and Electric Company the officers elected were: President, Sidney W. Winslow; Clerk and Treasurer, Andrew W. Rogers; Directors, S. W. Winslow, A. W. Rogers, H F. Winslow and C. F. Prichard.

THE proprietors of the Dover (Del.) Gas Light Company have reduced the selling rate to $1.50 per 1,000 cubic feet, a concession of 20 cents per 1,000.

IT is reported that the properties and interests of the Laclede Gas Light Company and of the Missouri-Edison Electric Company, of St. Louis, Mo., are to be merged. This would look like wisdom, in that a new contract for the public lighting of the city, to run for a term of years from Jan 1, 1900, must be considered.

A NEW corporation, to be known as the Union Gas and Electric Company, to take over and operate the properties of the Citizens Gas Light and Heating Company, the Citizens Electric Company and the Gridley gas plant (the latter is merely a chartered right), of Bloomington, Ills, has been incorporated. The new concern is capitalized in $400,000, and its Directors are: George W. Funk, James A. Wilcox, J. O. Willson; John T. Lillard and Willard Parritt. The Bloomington Electric Light Company remains an independent concern.

CAPTAIN S. E. LINTON, of Charlotte, N. C., has been appointed Superintendent of the reorganized gas and electric lighting interests of Raleigh, N. C.

MR. W. H. MCGOLDRICK, who capably managed the properties of the San Antonio (Tex.) Gas Company for some years as Superintendent, has resigned from the Company's service. He proposes to engage in business in San Antonio on personal account. May the best of good luck be his in his venture.

AT the annual meeting of the Northampton (Mass.) Gas Light Company the following officers were elected: Directors, L. C. Seelye, C. N. Clarke, D. W. Crafts, E. H. Banister and J. F. Starr; President, C. N. Clarke; Treasurer, E. H. Banister; Supt., D. W. Crafts; Asst. Supt., H. C. Crafts.

THE Special Committee of City Councils, Nashville, Tenn., having in hand the consideration of the propositions for the gas supply of that city, respectively submitted by the Nashville Gas Light Company and the Tennessee Gas Company (an opposition concern), has recommended the adoption of an ordinance relegating both propositions to a vote by the people at the election to be held next October.

OVER 500 gas ranges have been placed this season in Little Rock Ark.

THIS mention impels us to report the fact that Messrs. Poor, Thomas and Graf, of the Hackensack (N. J.) Gas and Electric Company, are smiling to, with and by themselves over the spread of the cooking-by-gas habit in Bergen county.

THE Morristown (N. J.) Gas Light Company will erect a substantial and handsome office structure on a site recently purchased by it on South street.

THE United Gas Improvement Company has subscribed $2,500 towards the guarantee fund of the National Export Exposition and Commercial Congress.

"T. S." is informed that the regular quarterly dividend of 2½ per cent. on the shares of the Brookline (Mass.) Gas Light Company was declared payable the 1st inst.

THE Torrington (Conn.) gas plant will be completed and in working operation by September 1st. The gas rate agreed on is $1.60 per 1,000 cubic feet, less 10 cents per 1,000 for prompt payment.

AT the annual meeting of the Fall River (Mass.) Gas Works Company the officers chosen were: Directors, John S. Brayton, Charles M. Shove, George P. Brown and Joseph A. Baker, of Fall River, and Samuel T. Bodine, Randall Morgan and Walton Clark, of Philadelphia; President, John S. Brayton; Vice-President, Joseph A. Baker; Clerk and Treasurer, George P. Brown; Treasurer, Edward C. Lee; Superintendent, Joseph E. Nute.

(*Continued on page* 215.)

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ELBERT P. CALLENDER,
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AGENTS:

New York—American News Co., 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, AUG. 7, 1899.

(*Continued from page* 214.)

THE New England Gas and Coke Company reports a shipment of 2,500 tons of coke to Mexico City. It is said to be the first shipment of coke from the United States to Mexico.

THE Philadelphia Suburban Gas Company has made an offer, which is likely to be accepted, for the plant and franchises of the Media (Pa.) Gas Company.

THE Kewanee (Ills.) Gas Light and Coke Company has been absorbed by the Kewanee Light and Power Company. The President of the latter is Mr. Xenophon Caverno, and Mr. John G. Ingham is its Secretary and Treasurer.

A CORRESPONDENT forwards the following extracts from the annual report of Mr. Calvert Ford, inspector of gas and gas meters for the District of Columbia, which report covers the twelvemonth ended June 30: The illuminating power of the gas supplied by the Washington Gas Light Company during the past fiscal year was .64 of 1 candle higher than that supplied during the previous year. The mean average illuminating power determined at the three laboratories was found to equal 26.36 standard candles, the maximum power being equal to 30.16 standard candles, while the minimum was 22.81 candles. The illuminating power of the gas supplied by the Company was not found less than 25 standard candles on any occasion during the year. On 51 occasions during the year the impurity known as sulphureted hydrogen was found in the gas supplied by this Company. This showing, says Mr. Ford, exhibits a decrease in the number of occasions as compared with the record for the preceding year, but still this impurity, he states, should be entirely eliminated from the gas supplied to consumers, and every expedient should be resorted to to overcome and dissipate this annoying compound. The average illuminating power of the gas supplied by the Georgetown Gas Light Company during the year was .02 of 1 candle less than the average for the preceding year. The mean average power of the gas supplied by the Georgetown Company was found equal to 27.68 standard candles. On seven occasions it was found to be less than 25 candles, on two of the occasions being slightly less than 24. The presence of sulphureted hydrogen was found on three occasions. The illuminating gas supplied by the two Companies, says Mr. Ford, was of fine quality, and the showing made by the Companies, he believes, cannot be excelled by any other gas company in the United States, unless possibly by one or two of the New York city companies, which use oil gas. In very few cities of the country is the inspection of gas and meters as thoroughly attended to, says Mr. Ford, or as often made, as in the District. Here inspections are made, he states, every working day, while in Boston during the year 1898 but 52 were made. During the past year his office inspected and proved 3,984 gas meters in the District. Of these 189 registered fast, the average error being 4.72 per cent.; 524 registered slow, with an average error of 11.35 per cent.; 3,024 registered within the limits allowed, and 242 did not register the gas flowing through them. On complaint of the two Companies and consumers 1,198 of these meters were removed from service. Of the 424 complained of by consumers, who believed the meters registered incorrectly, 165 registered fast, with an average error of 4.80 per cent.; 28 registered slow, with an average error of 4.67 per cent., and 231 registered within the limits allowed. Of 774 meters complained of by the Companies 19 registered fast, with an average error of 4.77 per cent.; 501 registered slow, with an average error of 17.94 per cent.; 12 registered within the limits, and 242 did not register the gas flowing through them. The Washington Company tested 764 of the the complained of meters. The reason so many meters were found to register slow, says Mr. Ford, and not registering at all was due to the fact that meters of this class were removed from service by the Company under the belief that they were registering slow, and before being brought to the inspector's office were tested at the Company's shop to ascertain their condition. Under this condition, says Mr. Ford, it is not likely that he would often find meters of this description registering fast or registering within the limits allowed by law. The sum of $1,646 was received by the office for the inspection of meters during the past year and paid to the collector of taxes. "Consumers of gas," says Mr. Ford, "frequently complain of the small reduction made on their gas bills by the Gas Companies of this District when the inspector of gas and meters finds their meters registering fast. It is the custom of the Gas Companies in this District to allow reduction only on the current bill, and that according to the percentage of error found by the inspector. In Baltimore and New York a much more liberal allowance is made by the Gas Companies when the Inspector finds consumers' meters running fast. The General Superintendent of Lamps and Inspector of Meters in Baltimore informs me that when meters are removed on complaint of consumers of gas, and found to register too fast, the consumer has the right to demand from the Gas Company a reduction from the past four months' bills the percentage that his meter is registering against him. The Secretary of the Consolidated Gas Company of New York says when meters are registering too fast it is the custom of this Company to allow the gas consumers a rebate for the full amount, as indicated by the test certificate of the meter inspector, for one-half of the time that the meter was in use, provided the consumer's account covered the period named. In view of the great difference in favor of the gas consumers in Baltimore and New York, as compared with the gas consumers in the District of Columbia, in cases as stated above, I would recommend that the Washington and Georgetown Gas Light Companies be requested to make a more liberal allowance than is at present made in cases where the consumers' meters are found by the inspector to be registering fast." Mr. Ford recommends that the salary of the assistant inspector be increased from $1,000 to $1,200 per annum; that an additional inspector be employed at $720 per annum, the work of the office having largely increased and the work being at times considerably behind, and that the salary of the messenger be increased from $480 to $600 per annum. Mr. Ford also recommends that the hours of the office, from 8 A.M. to 5 P.M., be reduced so as to conform to the hours in force in other departments of the District government.

The Market for Gas Securities.

The market for city gas shares showed neither length, breadth nor depth last week, and whatever prices were made were of the most artificial sort. Consolidated sold up to 182 and down to 175½, the latter figure being the quotation at 2 P.M. to-day—Friday. These prices are altogether the result of manipulation, for there is no change in the situation, which remains in the chaotic state which has prevailed since last May. Take it all in all, the strength shown in Consolidated must be disappointing to the financiers who are attempting to shake out investment stock. We strongly advise its purchase, in face of the oft repeated rumor that the Company will either cut its dividend for the quarter to 1 per cent. or pass it altogether. Other city gas shares are fairly steady, notably Amsterdam common, which seems to have been "pegged" at 32 or thereabouts.

Brooklyn Union is 142 bid, but holders thereof should not lose sight of the danger to it of the situation in Manhattan. Peoples, of Chicago, is 120¼ to 120⅝. The regular quarterly dividend thereon of 1½ per cent. is payable the 25th inst. Cincinnati gas is going back to its normal value, being bid 191, offered at 196. Washington (D. C.) gas is 275 bid, and Bay State is reported "strong" at 1¾ to 2. Lacledes are in good demand at advancing figures, the rise being presumably based on the idea that the gas and electric lighting interests of St. Louis are to be harmoniously combined. Mr. W. P. Taylor, Treasurer of the Wilmington (Del.) Coal Gas Company, has notified the shareholders that a dividend of $3 per share has been declared, payable on demand.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks,

16 WALL STREET, NEW YORK CITY.

AUG. 7.

☞ All communications will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$39,078,000	100	175	176
Central Union, Bonds, 5's.	3,000,000	1,000	107¼	108½
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	260	..
" Bonds	1,500,000	1,000	100	102

Municipal Bonds	750,000	.	..	
New Amsterdam Gas Co.	13,000,000	100	33¾	34¼
Preferred	10,000,000	100	58½	60
Bonds, 5's	11,000,000	1,000	100½	101
Northern Union, Bonds, 5's.	1,250,000	1,000	95	97
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	109	111
" 1st Con. 5's	1,500,000		112	114
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	112	..
Preferred	5,000,000	100	135	138
Bonds, 1st Mortgage, 5's	1,500,000	1,000	112	114
Yonkers	299,65	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	142	..
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State	50,000,000	50	1⅞	2
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works..	450,000	100	40	..
" 1st Mtg. 5's	450,000	1,000	95	98
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	92	..
2d " " "	3,000,000	1,000	68	71
Buffalo City Gas Co.	5,500,000	100	8¾	9½
" " Bonds, 5's	5,250,000	1,000	84	85
Central, San Francisco	2,000,000	..	105	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus	1,144,700	100	70	75
1st Mortgage	1,207,000	1,000	106	108
Consumers. Jersey City	2,000,000	100	95	.
" Bonds	600,000	1,000	107½	110
Cincinnati G. & C. Co.	8,500,000	100	182	183
Consumers, Toronto	1,700,000	50	230	235
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000		
Consolidated, Baltimore	11,000,000	100	62¾	62¼
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	21	23
" Con. Mtg. 5's	380,000	1,000	87	90
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,560,000	50	65	65½
" Prior Lien 5's	4,546,000	1,000	94¾	94½
Detroit Gas Co., 5's	423,000	1,000	95½	96
" Inc. 5's	31,000	100	..	..
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	77	83
" Bonds	2,000,000	..	80	85
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	..
Hartford	750,000	25	..	220
Indianapolis	2,000,000	..	122	128
" Bonds, 6's	2 650,000	..	105	106
Jackson Gas Co	250,000	50	50	..
" 1st Mtg. 5's	250,000	1,000	96	100
Jersey City	750,000	20	225	275
Lafayette Gas Co., Ind.	1,000,000	100	68	70
Bonds	1,000,000	1,000	81	86
Louisville	2,570,000	50	106	108
Laclede, St. Louis	7,500,000	100	50¾	..
Preferred	2,500,000	100	98	..
Bonds	10,000,000	1,000	107	108
Madison Gas & Elec. Co.	400,000	100	82	85
" 1st Mtg. 6's	350,000	1,000	102	..
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co	1,000,000	..	200	220
Bonds, 6's	4,000,000	..	128	130x
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	53¾	55
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	120¼	120⅝
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	111½	112
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	215	..
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	70	73
St. Paul Gas Light Co	1,500,000	100	50	52
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	80	82
St. Joseph Gas Co	1,000,000	100	42	44
" 1st Mtg. 5's	750,000	1,000	96	99
Syracuse, N. Y.	1,750,000	100	..	13
Bonds	1,612 000	1,000	81	84
Washington, D. C	2,800,000	20	275	..
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	99	100
Bonds, 5's	3,830,500	.	106	108
Wilmington, Del.	600,000		214	..

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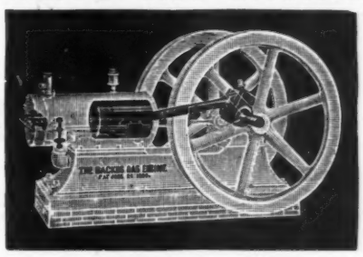

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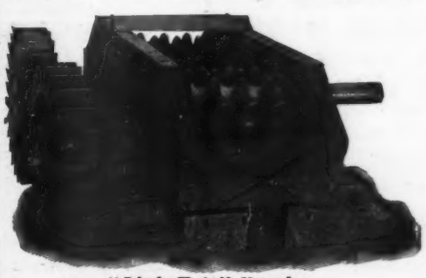

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GEO. R. HISLOP, F.C.S., F.R.S.S.A., Gas Engineer of Paisley, Scotland, says in his analysis: "This is a remarkably rich Cannel Coal, yielding illuminating matter per ton equivalent to 1,945 lbs. of sperm candles."

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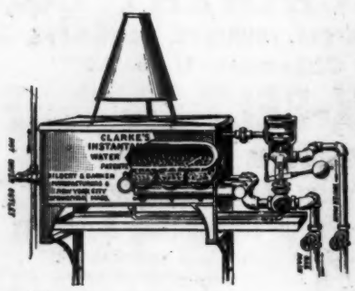
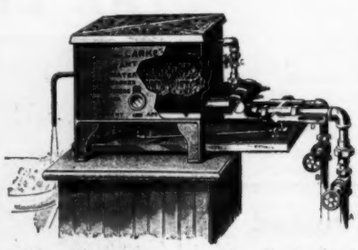


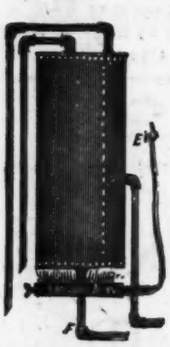
This **AUTOMATIC INSTANTANEOUS WATER HEATER** furnishes water heated as it flows. The act of drawing water from any faucet with which it is connected automatically turns on the gas, which is in the same way instantly shut off when the flow of water is stopped at the faucet.



This **INSTANTANEOUS WATER HEATER** is not automatic. *A* is the gas pipe; *B* the water supply pipe; *E* the pilot light; *D* is a double cock by which both gas and water are controlled by *one movement*. The flow of water is adjusted by the cock *C*, so that *live* steam may be discharged in *thirty seconds*, or hot water as desired.

GILBERT & BARKER MFG. CO., 82 John Street, New York.

An Economical Hot Water Heater.



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Will heat the Water in a Boiler in less than half the time required by a Range, and at less than half the expense. Nothing to get out of order, and will last a lifetime.

BUFFALO CITY GAS CO., BUFFALO, N.Y., April 1, 1899.
J. P. B. SADTLER & Co., 813 S. Howard St., Baltimore, Md.
Gentlemen—Replying to your favor of the 30th of March. The Heller Heaters that you have already furnished seem to be large enough, and we will not at present care to use any of the larger size that you mention. We have had no complaint in regard to the Heller Heater that we have used in Buffalo, and so far they are giving us good satisfaction.
Yours very truly, E. H. JENKINS, Engineer.

BALTIMORE, MD., March 24, 1899.
J. P. B. SADTLER & Co., 813 S. Howard St., Baltimore, Md.
Gentlemen—A test of the Heller Water Heater witnessed by me March 21, 1899, showed that with a consumption of 30 feet of gas per hour, the water in a 28 gallon galvanized boiler could be heated from 59° to 102°, or 43° in one hour. Temperature of room at time of test 64°.
Respecfully,
GEO. BEADENKOPP, Ass't Engineer, Con. Gas Co.

Clamp Heater to Pipe about 4 inches away from bottom of Boiler. Always use an independent connection, or regular Gas Stove connection, so as to get a good flow of Gas.

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	Cubic Feet Daily.
Blackburn, Eng.	1,250,000
Windsor Street Works, Birmingham, Eng.	2,000,000
Saltley Works, Birmingham, Eng.	2,000,000
Colchester, Eng.	300,000
Birkenhead, Eng.	2,250,000
Swindon (New Swindon Gas Co.), Eng.	120,000
Saltley Works, Birmingham, Eng. (2d Contract)	2,000,000
Windsor St. W'ks, Birming'm, Eng. (2d Contract)	2,000,000
Halifax, Eng.	1,000,000
Toronto,	250,000
Ottawa,	250,000
Toronto (Second Contract, Remodeled),	2,000,000
Lindsay (Remodeled),	125,000
Belleville,	250,000
Ottawa (Second Contract),	250,000
Brantford (Remodeled)	200,000
St. Catherine's (Remodeled),	250,000
Kingston, Pa.	125,000
Montreal,	500,000
Peterborough, Ont.	250,000
Wilkesbarre, Pa.	750,000
St. Catherine's (Second Contract),	250,000
Buffalo, N. Y.	2,000,000
Winnipeg, Man.	500,000
Colchester, Eng. (Second Contract),	300,000
York, Eng.	750,000
Rochester, Eng.	500,000
Kingston, Ont.	300,000
Crystal Palace District, Eng.	2,000,000
Duluth, Minn.	300,000
Caterham, Eng.	150,000
Enschede, Holland,	150,000
Leicester, Eng.	2,000,000

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NONE BETTER MADE.

America's Standard Burner.
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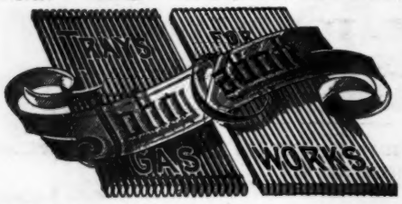
Reversible, Strongest, Most Durable, Most Easily Repaired.



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PRESSURE GAUGE.

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Also, Gate Fire Hydrants with and without Independent Nozzle Valve. All Work Guaranteed.

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THE GAS ENGINEER'S POCKET-BOOK.

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Comprising Tables, Notes and Memoranda relating to the Manufacture, Distribution and Use of Coal Gas, and the Construction of Gas Works.

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Having compiled a novel Chart or Map illustrating the various

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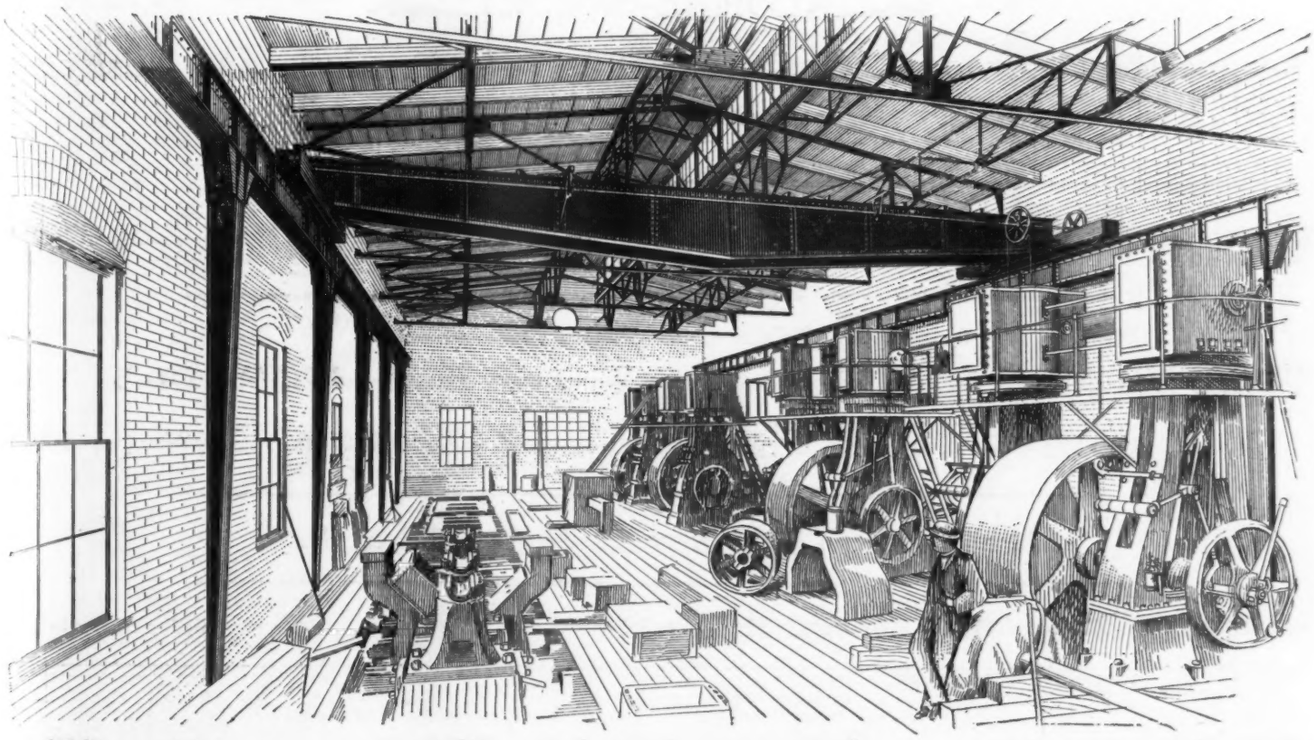
Engineers, Architects and Builders of Steel Structures.



The above illustration is taken direct from a photograph and shows the interior of Power House designed and built by us for the Worcester Traction Company, at Worcester, Mass. The building is 47 feet wide and 120 feet long, with a traveling crane as shown. The roof being very flat, it is covered with plank, tar and gravel. The entire framework is of steel, a light brick wall being placed between the posts to protect the interior of the building from the weather.

BOSTON OFFICE, 200 Equitable Building.
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Gas Investments in California.

Nowhere else on this continent does such opportunity exist for profitable gas investment as on the Pacific Coast, since the perfection of the new LOWE Process for using the heavy crude California oils (of which there is an unlimited supply) without the use of any other fuels. Seven years' test proves the system to be perfect in every respect. Los Angeles alone, in addition to present street mains, has 150 miles of well built up streets without a gas main on them. To occupy this territory, and a large number of other towns now without gas, we have organized a parent company and a number of local companies covering some of the fastest growing cities in the United States.

Now is the time to invest, when the first capital will be able to double itself in a single year. This is also the most delightful residence section in the United States.

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The accompanying cut shows the oil wells in the suburbs of Los Angeles from which the Companies under the NEW LOWE GAS PROCESS obtain their supply of oil.

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Constructors of Coal Gas Apparatus.

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Recuperative Furnaces, Washers, Condensers, Purifiers and Purifying Machines, Ammonia Plant, Coke Conveyers, Etc.

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P. H. & F. M. ROOTS CO.'S
Exhausters, Blowers, etc.

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LATEST IMPROVED GAS EXHAUSTER

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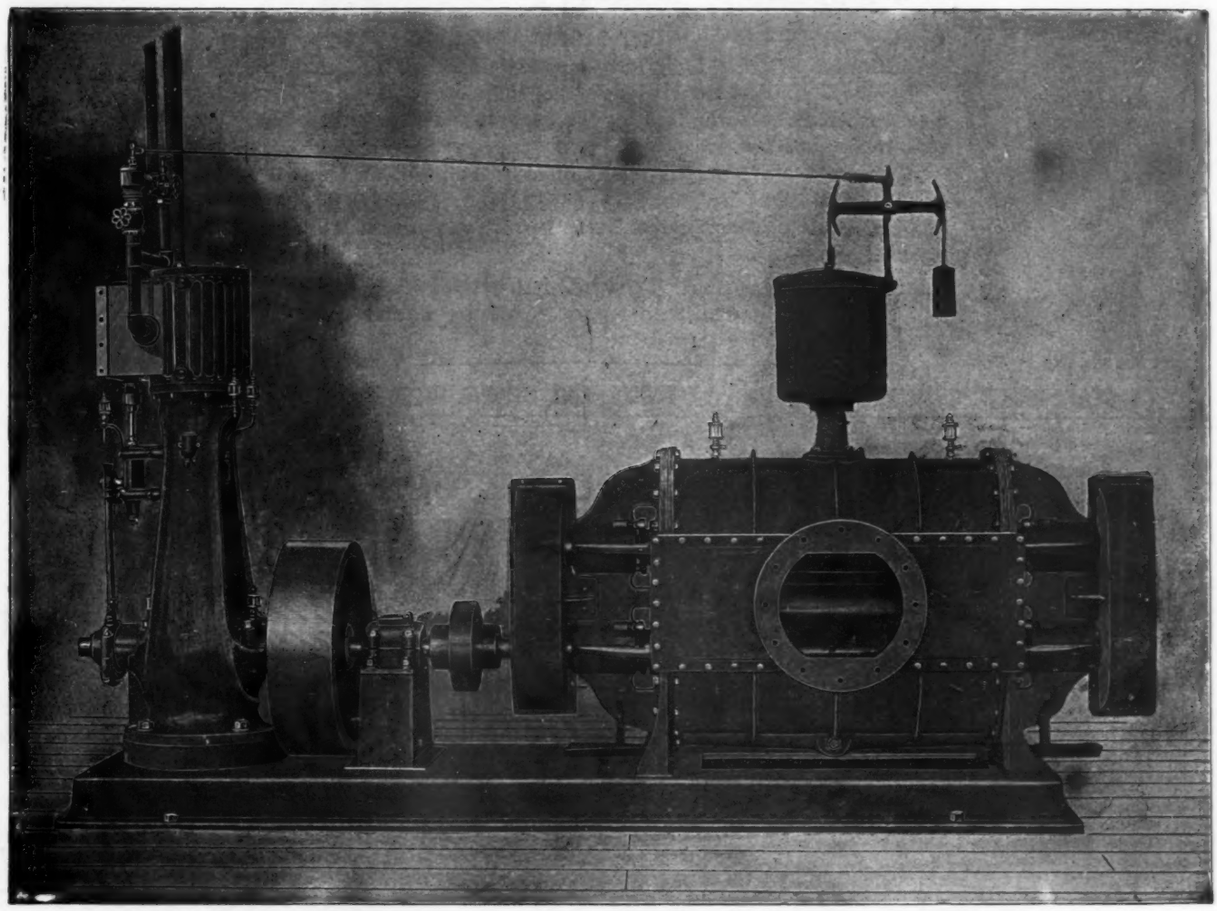
NEW GAS GOVERNOR AND STEAM VALVE.

GUARANTEED TO REGULATE WITHIN ONE-TENTH OF AN INCH, WATER PRESSURE.

The Most Perfect Gas Governor on the Market.

MORE DIRECT IN ACTION. FEWER PARTS.
EASIER TO ADJUST THAN ANY OTHER GOVERNOR.



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—OWNS, CONTROLS AND OPERATES—
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THE NEW IMPROVED AND PATENTED STREET LIGHT BURNER.

STYLE No. 81.

Our PATENTED "STREET LIGHT APPLIANCES" have made WELSBACH STREET LIGHTING a complete success.

By the UNIFORM DISTRIBUTION of light on scientific principles a greater area can be lighted by our system and more economically than in any other way.

Where there are no gas mains already laid, we can furnish an equally good light by our **SELF-GENERATING NAPHTHA WELSBACH BURNER,** enabling Gas Companies to furnish a uniform light in all localities.

Lists of Cities and Towns in which we are now lighting under contract will be furnished upon application.

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CORRESPONDENCE SOLICITED FROM GAS COMPANIES AND OTHERS INTERESTED IN MUNICIPAL LIGHTING.

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THE SIXTH (AND CENTENARY) EDITION
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This Edition of the "Handbook for Gas Engineers and Managers" is a great improvement on all previous editions Much of the text has been re-written, in order to keep the work abreast of the constant advances that are being made in the Gas Industry.

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GAS ENGINES

With Instructions for Care and Working of the Same.

By G. LIECKFELD, C.E.

Translated with Permission of the author by GEO. M. RICHMOND, M.E.

Price, $1.00.

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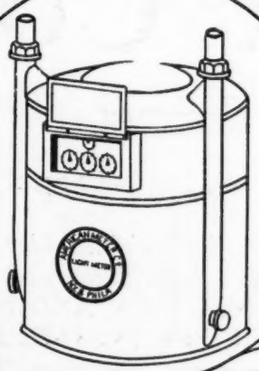

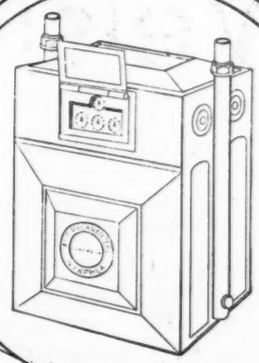

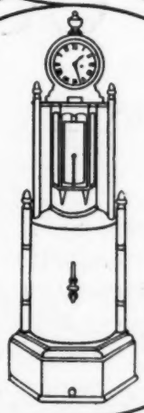

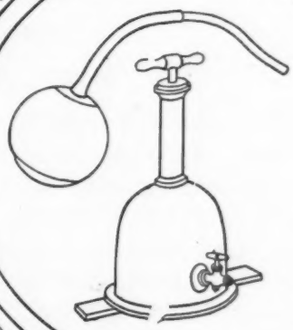

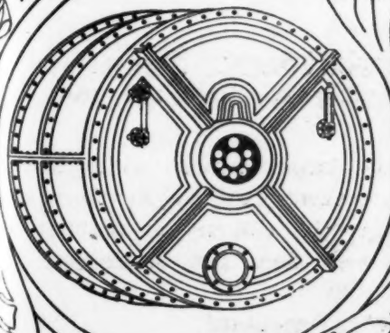

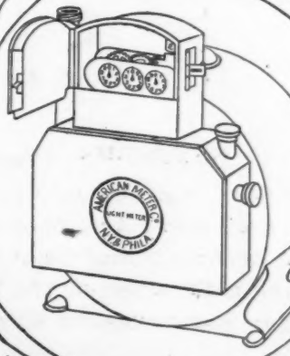

PUBLIC LIGHTING TABLE.

AUGUST, 1899.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Tue.	1	7.40 PM	2.20 AM	7.10	3.30
Wed.	2	7.40	4.00	7.10	3.30
Thu.	3	7.40	4.00	7.10	3.30
Fri.	4	7.40	4.00	7.10	3.30
Sat.	5	7.40 NM	4.00	7.10	3.30
Sun.	6	7.30	4.10	7.10	3 45
Mon.	7	7.30	4.10	7.10	3.45
Tue.	8	7.30	4.10	7.10	3.45
Wed.	9	7.30	4.10	7.10	3.45
Thu.	10	7.40	4 10	7.10	3.45
Fri.	11	8.10	4.10	7.10	3.45
Sat.	12	8 30	4.10	7.10	3.45
Sun.	13	9.10 FQ	4.10	6.55	4.00
Mon.	14	9.50	4.10	6.55	4.00
Tue.	15	10.50	4.10	6.55	4.00
Wed.	16	11.50	4.10	6.55	4.00
Thu.	17	1.00 AM	4.10	6.55	4.00
Fri.	18	2.40	4.10	6.55	4.00
Sat.	19	No L.	No L.	6.55	4.00
Sun.	20	No L. FM	No L.	6.45	4.10
Mon.	21	No L.	No L.	6.45	4.10
Tue.	22	7.10 PM	8.20 PM	6 45	4.10
Wed.	23	7.10	8.50	6.45	4.10
Thu.	24	7.10	9.30	6.45	4.10
Fri.	25	7.10	10.00	6.45	4.10
Sat.	26	7.10	10.40	6.45	4.10
Sun.	27	7.10 LQ	11.30	6.30	4.20
Mon.	28	7.10	12 20 AM	6.30	4.20
Tue.	29	7.10	1.10	6.30	4.20
Wed.	30	7.10	2.10	6.30	4.20
Thu.	31	7.10	3.10	6.30	4.20

TOTAL HOURS LIGHTING DURING 1899.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	215.40	January	423.20
February	184.40	February	355.25
March	187.40	March	355.35
April	166.50	April	298.50
May	158.00	May	264.50
June	140.50	June	234.25
July	150.30	July	243.45
August	168.30	August	280.25
September	179.50	September	321.15
October	213.20	October	374.30
November	217.00	November	401.40
December	238.10	December	433.45
Total, yr.	2221.00	Total, yr.	3987.45

OFFICE OF THE

Welsbach Light Co.,

BROAD AND ARCH STREETS,

PHILADELPHIA, PA., June 23, 1899.

To the Stockholders of the Welsbach Light Company:

In answer to the many inquiries received from the stockholders as to whether the Welsbach Light Company is interested in the Kern Light or the Kern Incandescent Gas Light Company, I am authorized by the Board of Directors of this Company to advise you that **THIS COMPANY IS NOT NOW AND NEVER HAS BEEN INTERESTED IN EITHER THE KERN LIGHT OR THE KERN INCANDESCENT GAS LIGHT COMPANY. The Kern Light, or, to designate it more properly, the Kern Bunsen Burner for use with an incandescent mantle, and the United States patents upon which it is based, were offered to this Company, which refused to purchase them upon the advice of its experts, Dr. Charles F. Chandler, of Columbia College, and Dr. Waldron Shapleigh, its Chief Chemist, and of its Patent Council, Mr. John R. Bennett, of New York City.**

This Company is not now and never has been interested in the Welsbach Incandescent Gas Light Company of England, nor is that Company interested in this Company. Your attention is called to the following correspondence, which defines **THE POSITION OF THE UNITED GAS IMPROVEMENT COMPANY**, whose name is mentioned in the advertisements which offer for subscription the stock of the Kern Incandescent Gas Light Company.

WELSBACH LIGHT COMPANY,
W. E. BARROWS, President.

WELSBACH LIGHT CO.,

BROAD AND ARCH STREETS,

PHILADELPHIA, PA., June 23d, 1899.

MR. THOMAS DOLAN, President the United Gas Improvement Company:

DEAR SIR: In yesterday's and to-day's New York and Philadelphia papers appear the advertisements of the International Banking and Trust Company soliciting subscriptions to the Capital Stock of the Kern Incandescent Gas Light Company. Among the names of the Directors of the said Trust Company published in the advertisements referred to appears the name of "George W. Elkins, United Gas Improvement Company, Philadelphia." As the United Gas Improvement Company has been prominently identified with the Welsbach Light ever since its introduction into the United States, the publication of its name in these advertisements, which also contain suggestions hostile to this Company, has greatly disquieted many of our shareholders. If you are willing to give me an authoritative statement of the position of the United Gas Improvement Company I shall be greatly obliged. Very truly yours,

W. E. BARROWS, President Welsbach Light Company.

THE UNITED GAS IMPROVEMENT COMPANY,
Broad and Arch Sts., Philadelphia, June 23d, 1899.

COL. W. E. BARROWS, President Welsbach Light Company:

Dear Sir: Answering your favor of even date, the United Gas Improvement Company is not now and never has been interested either in the Kern Incandescent Gas Light Company or in the International Banking and Trust Company. Mr. George W. Elkins is neither an Officer nor a Director of the United Gas Improvement Company, and does not represent the United Gas Improvement Company. Very truly yours,

THOMAS DOLAN, President,
United Gas Improvement Company.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

THE STANDARD JUNIOR,

THE STANDARD DOUBLE SUPERHEATER,

LOWE WATER GAS APPARATUS.

Under Contract, 1899:

	SETS.	DAILY CAPACITY.
Fostoria, O.	1	250,000 Cubic Feet.
Derby, Conn.	1	750,000 "
Lowell, Mass.	1	1,000,000 "
Doylestown, Pa.	1	50,000 "
Darby, Pa.	1	400,000 "
Adrian, Mich.	1	125,000 "
Concord, N. H.	1	400,000 "
Sioux City, Iowa	1	750,000 "
Standard Gas Light Co., New York	3	5,400,000 "
Peekskill, N. Y.	1	250,000 "
Westchester, N. Y.	1	250,000 "
Jersey City, N. J.	1	1,000,000 "
Stapleton, N. Y.	1	750,000 "
London, O.	1	125,000 "
Chicago, Ills.	2	3,600,000 "
Putnam, Conn.	1	125,000 "
Mansfield, O.	1	250,000 "
Plymouth, Pa.	1	125,000 "
Athens, Pa.	1	125,000 "
Charlotte, N. C.	1	250,000 "
Total	23	15,975,000 "
Previously built	294	187,100,000 "
Grand Total	317	203,075,000 "

Established 1858. Incorporated 1890.
CHAS. E. GREGORY Prest. DAVID R. DALY V. Prest. & Treas.
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Office, 88 Van Dyke St. Brooklyn, N. Y.

Established 1854. Incorporated 1869.

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FIRE BRICK . . .
RETORT SETTINGS

Water Gas Cupola Linings, Fire Clay, Etc.

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The Mitchell Half-Depth Regenerative Furnace.

This is the *original* coal-consuming Furnace for Retort Benches. Burns either Coal or Coke. Full and Half-Depth Regenerative Furnaces for Benches of 6's, 7's, 8's or 9's erected complete.

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Gas Retorts,

TILES, FIRE BRICK.

AND EVERYTHING IN THE FIRE CLAY LINE.

Adam Weber,

Proprietor,

Manhattan Fire Brick and Enameled Clay Retort Works.

Works, Weber, N. J.

Office, 633 East 15th St., New York.

Modern Recuperative Furnaces

And Standard Fire Brick and Gas Retorts.

Works, LOCKPORT STATION, PA.

—ESTABLISHED 1864.—

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Successor to WILLIAM GARDNER & SON

Fire Clay Goods for Gas Works.

SOLE REPRESENTATIVE OF THE McILHENNY REGENERATIVE BENCHES FOR THE U. S.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY

RETORT WORKS

WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,

BENCH SETTINGS,

Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

Price List, f.o.b. Galesburg or Mount Vernon.

In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD, Galesburg, Ills.

Eastern Agent, PERRY BORDEN, 19 Prospect Ave., MOUNT VERNON, N. Y.

Parker-Russell Mining and Mfg. Co.,

CITY OFFICE,
417 Pine Street, St. Louis, Mo.

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OAKHILL GAS RETORT & FIRE BRICK W'KS

Our immense establishment is now employed almost entirely in the manufacture of

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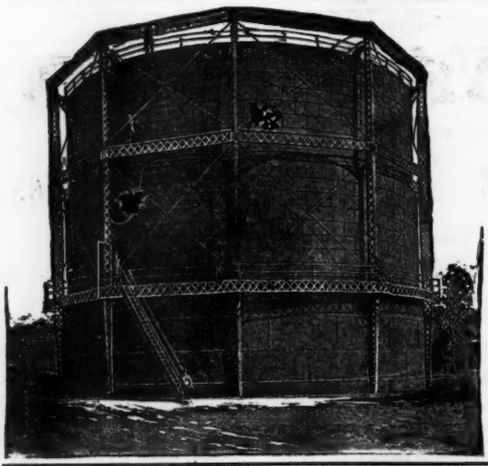

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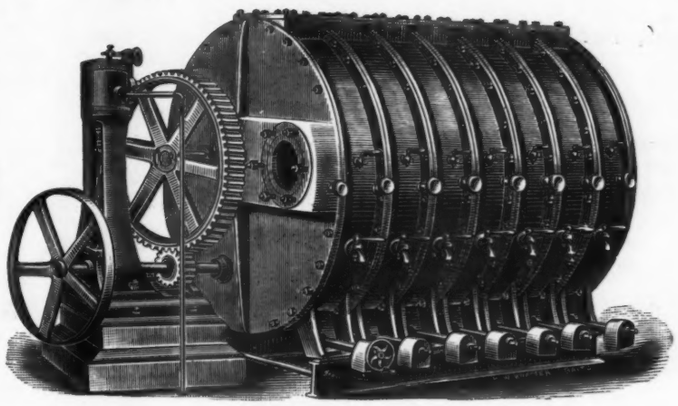

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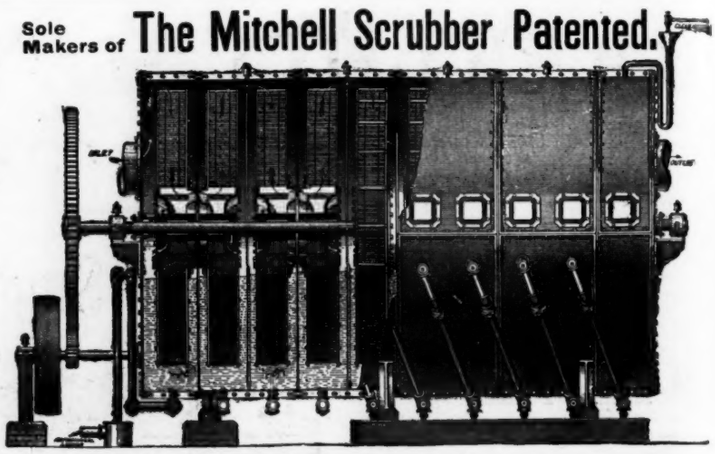

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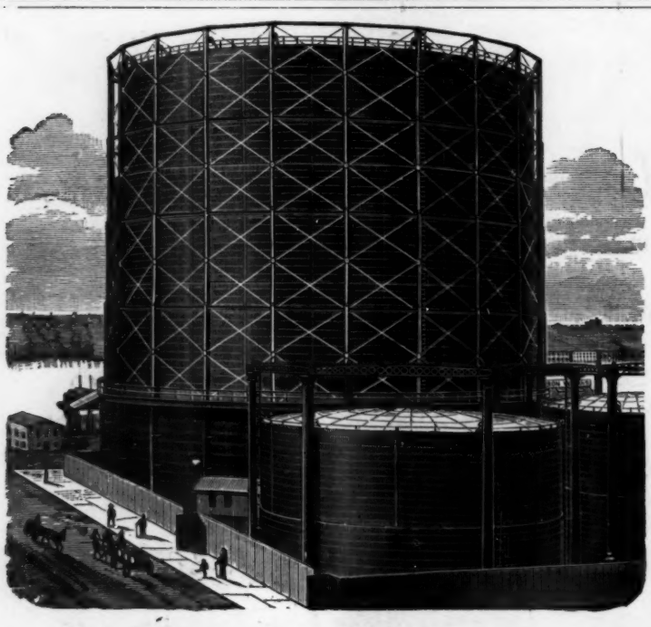

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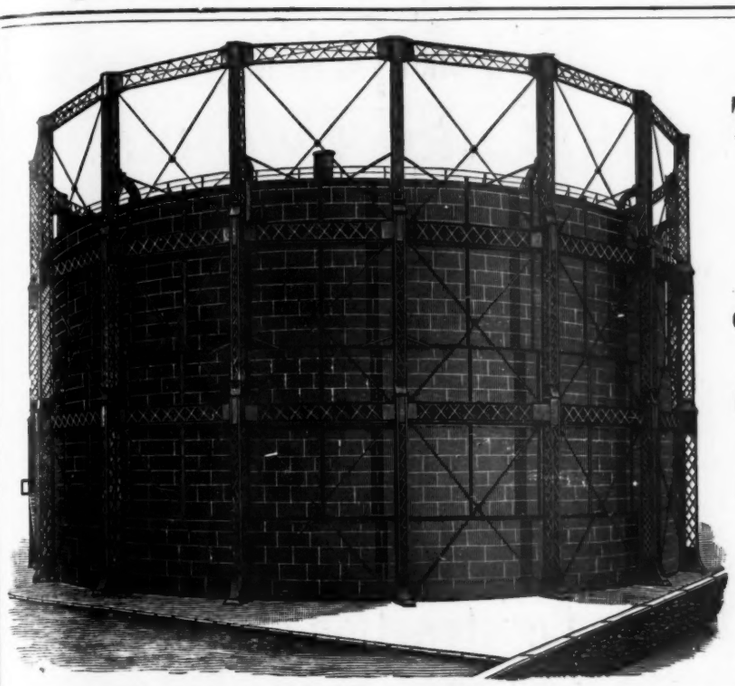

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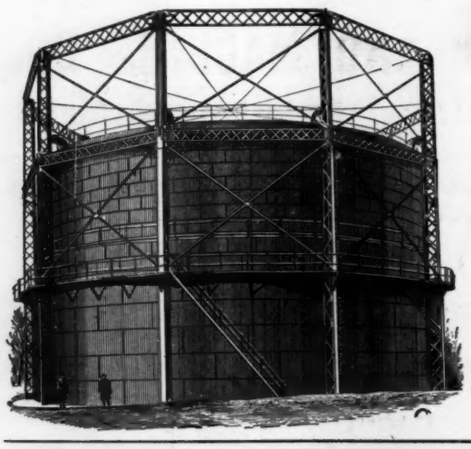

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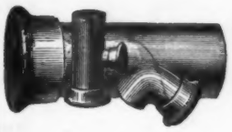

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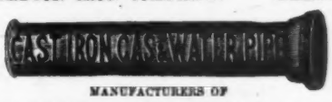

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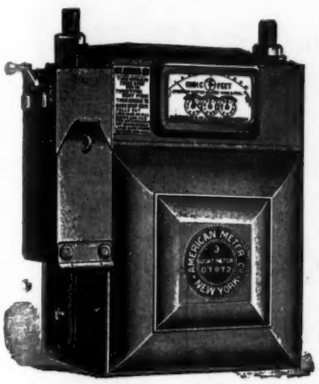

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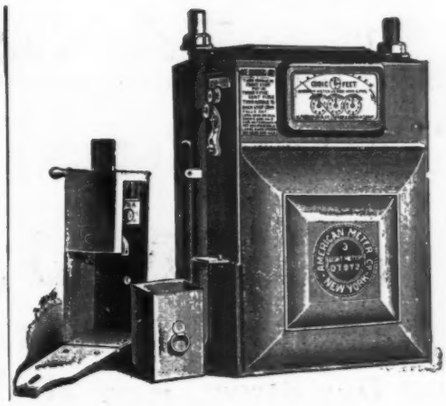

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